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APRIL 2002

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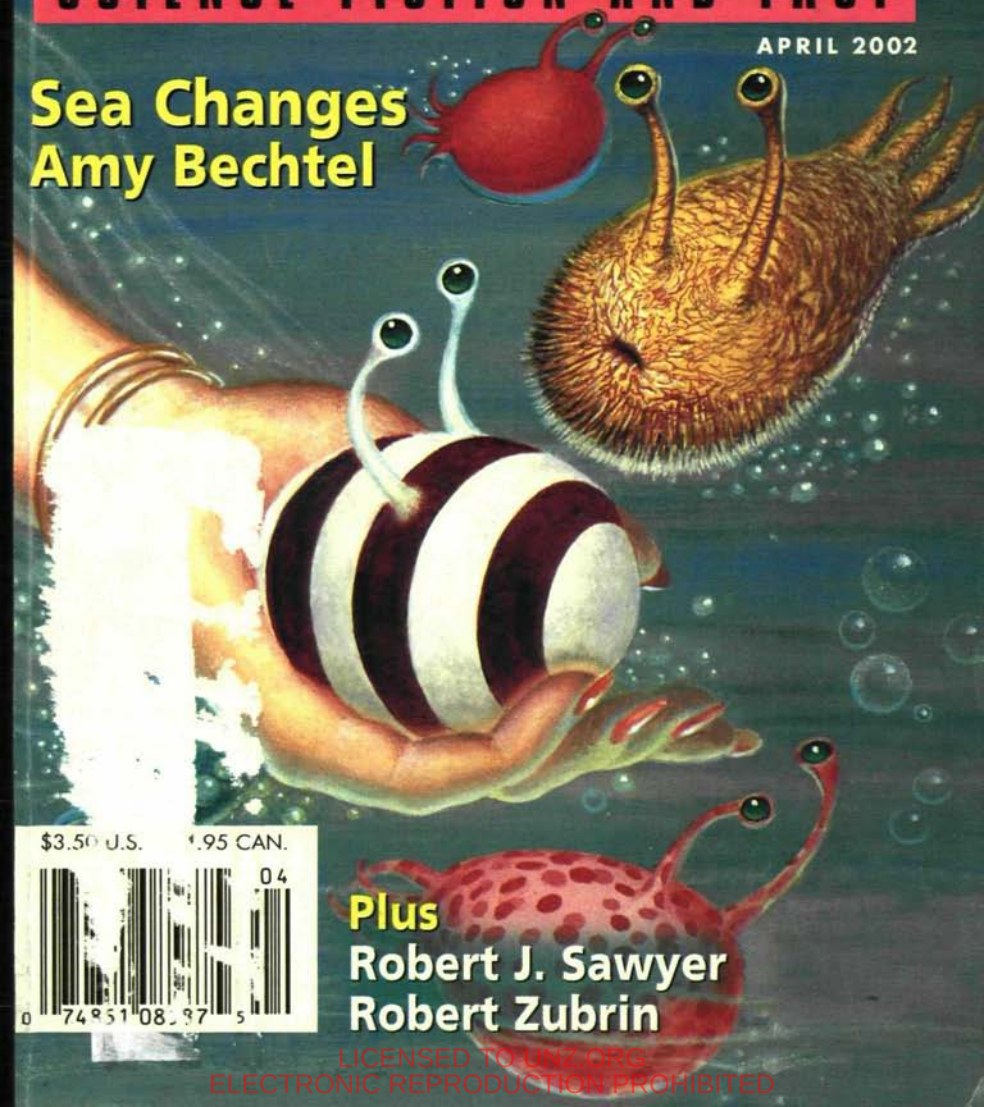

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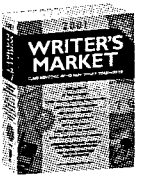

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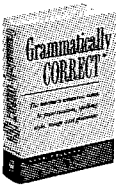

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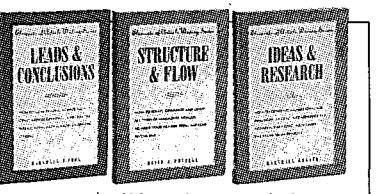

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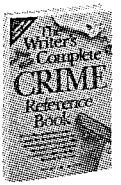

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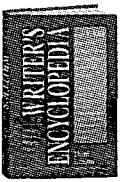

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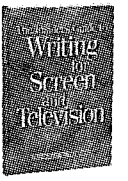

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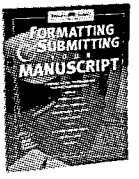

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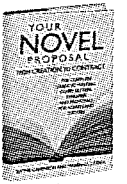

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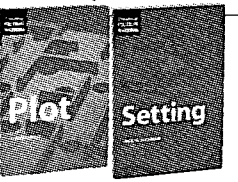

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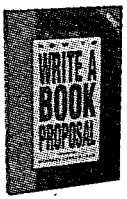

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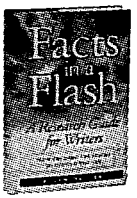

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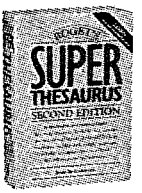

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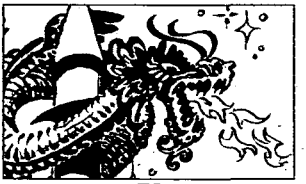

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The insidious concept of "planned obsolescence" has now been with us for quite some time, and, if anything, seems to be getting worse rather than better. I first heard it explicitly described (then under the name "dynamic obsolescence," if I remember rightly) about when I was in high school. It was a marketing philosophy being deliberately adopted by a sizable number of manufacturers for the usual reason of improving their bottom line, but could just as easily and convincingly be viewed as a subtly nasty plot against consumers.

The idea was to intentionally design products to fall apart in a relatively (and unnecessarily) short time. The ostensible reason was that most people would want to replace them with new, improved models in a few years anyway, so there was no point in building them to last any longer than that. This was actually advantageous to the consumer, we were sometimes told, because things built to last just long enough could be sold for less than the same things built to last beyond their likely "discard dates." The idea that replacing cheap things oftener than necessary could be more expensive in the long run than buying fewer good ones and making them last as long as possible was too subtle for most people, and was mentioned in *very* few ads.

And so began the slow, messy death of American frugality and careful use. When more and more things were deliberately built so that they *couldn't* last as long as they should, people more and more often had no choice but to buy "new and improved" things sooner than they wanted, and without regard for whether they wanted or needed the new features. From the start, this sort of rationalization thumbed its figurative nose at those people who had cultivated the habit of figuring out exactly what they wanted and needed and then taking care of it, and who were not highly susceptible to "Latest and Greatest Syndrome." LAGS, of course, is the uncritically held belief that you've just Gotta Have the most advanced technology available simply because it *is* the most advanced technology available. And manufacturers have done everything in their power to keep *that* alive and well.

Lately I've seen a growing tendency for manufacturers and vendors to go beyond "planned obsolescence" to "forced obsolescence." No longer content just to make things that wear out too fast, so people will have to buy new ones, they force people to buy replacements for things that *haven't* worn out by simply refusing to provide maintenance support for them after unreasonably short times. They stop providing repair parts and/or service long *before* things fall apart! In fact, to complicate the matter and add insult to injury, some things are actually being built *better* now than before, so that they *could* last longer. Yet the hapless owner who needs a small repair on an otherwise healthy unit may find nobody willing or able to do it, or to sell him the parts to do it himself.

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I submit a few examples from my own recent experience. My wife and I own (and like) a sizable collection of cameras, binoculars, camera bodies, and lenses from a well-known manufacturer—but unless that manufacturer changes its ways drastically, any future purchases that we *can* make from one of its competitors, we *will* make from one of its competitors. Several months ago, one of the lenses needed what should have been a relatively minor repair. A repairman promptly gave us an estimate, but then a couple of months went by while he waited for a part from the manufacturer. Finally (without giving any satisfactory explanation for why it took so long to determine this) he said parts were no longer available because it was "too old," so we would have to buy a new one. We grudgingly did, but not from that manufacturer. Our original was only eight years old, which is not too old by any reasonable measure. We consider it unconscionable for a photographic manufacturer to stop supporting its products (and customers) in less than fifteen, or at the very least ten, years; and we will not willingly support any that does so. In this case we didn't have to, because several manufacturers make quite respectable lenses to fit other manufacturers' bodies.

More recently, though, we had the same exasperating experience with one of the bodies, of the same vintage, and I don't know anybody who manufactures substitutes for those. To keep using all those lenses we've invested in from this company, we were stuck with getting another of their bodies. To their credit, they did provide (albeit grudgingly) a refurbished one of a similar model, at a price comparable to the repair estimate; but it took almost three months and was not enough to overcome the negative impression left by their hastened-obsolescence policy.

Eventually, of course, there will come a time when we have to replace the whole system, and when that time comes we do not currently expect even to consider buying the replacements from this company. When I complained about their reprehensible refusal to stand behind their products, I was told in their defense that they are a "leader in innovation." That's fine, but the one is not a substitute for the other. Some of us have a deep-seated need, whether innate or cultivated, for constant innovation *per se*, but some of us don't. And we will not willingly be bullied by a company that chooses to cater to one group at the expense of the other.

On another front, I recently needed to replace a temple on an eyeglass frame. One optometrist told me it would be hard to replace because eyeglass frame manufacturers stop making parts for them in about two years and typically sell out of existing stocks in three or four—despite the fact that I have typically been able to use this type of frame for ten years or so. One of his colleagues managed to find one, but at a price so

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close to that of a complete frame that the better part of valor—in a situation unreasonably forced on me—was to replace the whole thing, even though I only needed one small part of it now.

It's hard to see how some of these policies make sense even from the manufacturer's narrow, one-variable-only point of view. Eight years ago, we bought a very high-quality ceiling fan that came with a "lifetime" warranty. It also came with a wall-mounted remote control, and the option of getting a portable handheld remote simply by asking for it. The fan is still working beautifully; but the handheld remote, as the original price suggests, was not as well-made or durable. When ours wore out, I called the manufacturer to ask for a replacement. I was prepared to have to pay a few dollars for it; I was not prepared to be told that our fan was "obsolete" and they could no longer supply the remote. "You mean my 'lifetime guarantee' is now worthless?" quoth I, more than slightly annoyed. "Oh, not at all," came the reply. "We'll be glad to send you a catalog and you can pick out a new fan."

I am still puzzling over the fact that the manufacturer would rather give a customer a new fan costing at least a couple of hundred dollars than keep a few two-dollar remotes on hand as replacements. It is not obvious to me how that makes any economic sense for them, and it certainly doesn't for us. The old fan is still so good that there's no assurance we'd like a replacement as well, much less better—and in any case, changing it would involve an appreciable amount of electrical and mechanical surgery which I would either have to do myself or pay somebody else to do. So for the time being, at least, our decision is that the extra remote is not important enough to go through any of that—and that manufacturer, too, has taken a tumble on our repeat-business-desirability list.

Then there was the very recent case of my needing to replace three worn-out window shades in my home office. I didn't need anything fancy; I don't entertain or see clients there, I just write. All I needed was something to give me adequate control of the light getting into and out of the room. I wanted the process of getting it to disrupt my work as little as possible, and it seemed obvious to me that that should mean very little disruption indeed. These are simple

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roller shades of a type widely used for decades, and past experience said I should be able to go into a store, pick out a set of the same design, have them cut to length, and slip them into the existing brackets in a few minutes.

So I naïvely went to a nearby store that advertised itself as specializing in window shades, drapes, and blinds, figuring that it ought to have a good selection of merchandise and staff who could be trusted to cut it correctly. A salesman began very helpfully showing me a wide selection of available designs, all of which required their own special mounting hardware, which would in turn require me to spend at least an extra hour moving furniture out of the way, removing old hardware, making new measurements, drilling new holes, and driving new screws. When I interrupted to tell him what I really wanted, he said, "Oh, you're not going to find that now. Times change." So I thanked him for his time, called my trusty local hardware store, and mere minutes later had exactly what I wanted fully functional in my office, at a small fraction of what the specialty store had hoped to get from me. Question to ponder: Was the specialty merchant deliberately lying, in the hope of making a big sale to a mark who wouldn't bother to do any more research; or did he honestly not know that what I wanted *was* still easily available elsewhere? Should I be cynical or charitable?

Much of this was going on near the same time as the second Bush administration was winning points with its announcement of tax rebates to just about everybody, with the expressly avowed purpose of stimulating consumer spending. The juxtaposition of all these things leads me to muse that this might be a good time for all of us, individually and collectively, to rethink how we might restructure our economic ways and priorities so that spending is not seen as such an essential intrinsic good. Our present economic setup encourages and sometimes *forces* people to keep buying new things that they don't really need, so the people making them (which directly or indirectly includes practically everybody) can keep buying things *they* don't need. Isn't it just conceivable that we could find a way to scale back our definition of "needs" to a more realistic level, and create a new, sustainable system that would be better for both the world and its inhabitants?■

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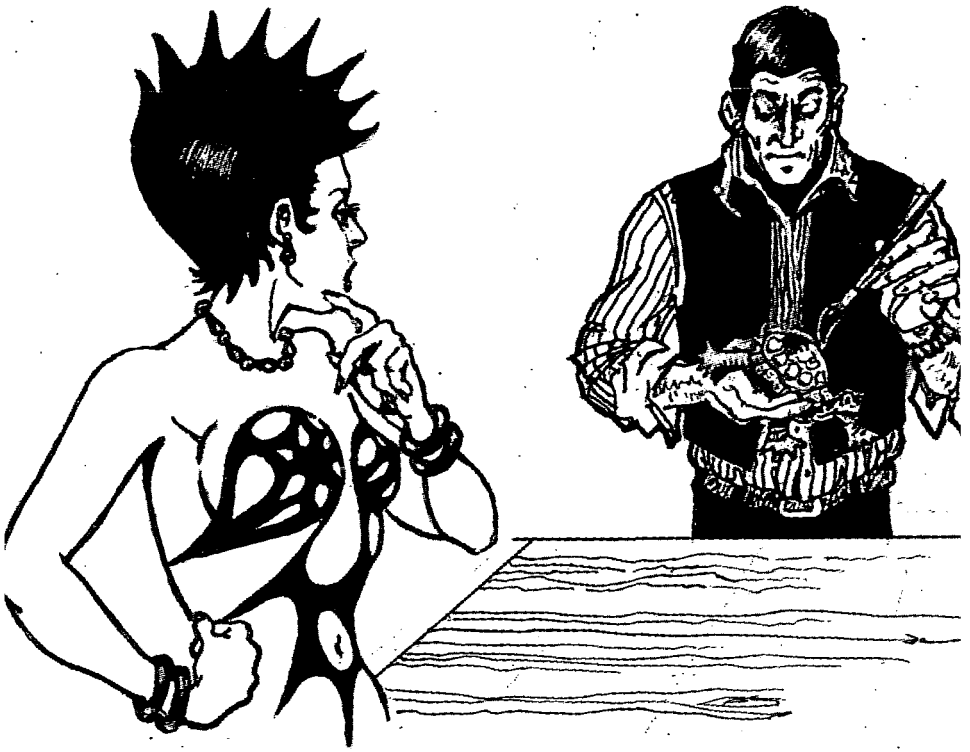
SEA CHANGES

Amy Bechtel

Illustration by Kelly Freas



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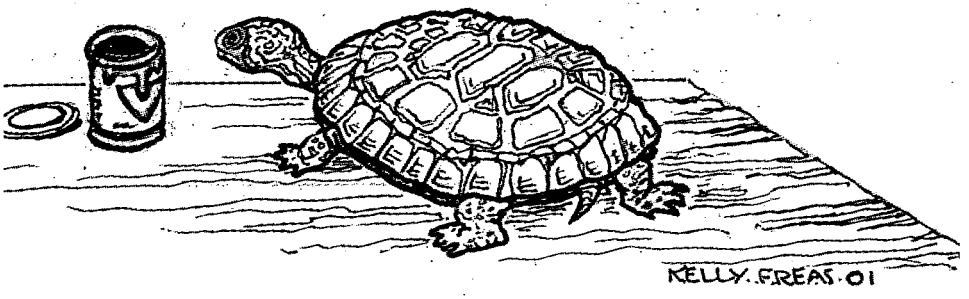
Doctors treat deviations
from normal—which is a perennial challenge
when you don't *know* what's normal!



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On my birthday, Howard Winston brought me a present.

It wasn't exactly my first present of the day. When I'd pulled into the parking lot of my veterinary clinic bright and early that morning, I'd found a large box on the doorstep. Now that isn't at all unusual. Most vets wind up with boxes of kittens and puppies abandoned on their doorsteps from time to time; it's really quite common. But *my* box held an eight-foot-long boa constrictor with beady reptilian eyes. It was just my luck. All I'd ever wanted was a quiet little practice, catering to ordinary animals like cattle and horses and dogs and cats. But my client Howard Winston also collected creatures like tortoises and snakes (not to mention his utterly unique sea monsters) and he had lots of friends with weird animals, and now they all came to see me. So I'd ended up with a reputation as a reptile vet, in spite of the fact that snakes give me the willies. Especially *big* snakes.

My assistant, Tegan, was impressed. "Wow, Michael," she said. "That's one big snake. What are you going to do with it?"

I looked at her hopefully. I knew she liked reptiles; she kept snakes in her home. "Would you like to have it?" I offered.

Tegan looked regretful. "No," she said. "It's too big for my apartment."

Apparently it had gotten too big for somebody else's apartment, too. I sighed and lugged the box into the building. Where was I going to put it? I had horrible visions of the snake crawling between the bars of my cages and devouring my patients; it certainly couldn't go in the kennel room. Finally I put the box in the storeroom, shut the door, and pinned a FREE SNAKE notice on the waiting room bulletin board.

By the end of the day, no one had volunteered to adopt my snake. Tegan had found an old aquarium out in the shed and had fixed it up into a decent little snake habitat. The boa now sat coiled in the aquarium, glowering at me.

"I wonder when it ate last," Tegan said.

"I guess we ought to, uh, offer it something," I said. "Soon." A big snake was bad enough on its own merits; a *hungry* big snake was unthinkable.

"Dr. Clayton?" My receptionist, Kami, cautiously cracked the storeroom door and peered inside. "That snake won't get loose, will it?"

I looked doubtfully at the aquarium. It really wasn't big enough; what if the snake got bored and decided to start dismantling it? I would definitely have to remember to keep the storeroom door shut. "I hope not," I said.

Kami didn't look reassured. "Howard Winston is here," she said, backing out of the room in a hurry and closing the door behind her.

Howard Winston and his wife Lynda were waiting for me in the exam room. Howard sat placidly in his chair with an aquarium in his lap; beside him, Lynda held a small cardboard box. Howard smiled at me and pushed his glasses up his nose. Howard is middle-aged and balding and very soft-spoken; to look at him you'd never guess that he was the cause of so many of my veterinary nightmares. Not the least of which was that Lynda, who'd once been my receptionist, had quit her job in order to be with Howard and his sea monsters.

"Hi, Michael," Lynda said. "Happy birthday. We brought you a present."

I looked at her sadly. "I don't suppose the present is that you're coming back to work for me?" She had been such a *good* receptionist.

"Sorry," Lynda said. "But you're not so bad off, are you? It looks like Kami's doing better."

This was true, although it was mostly because there was no way Kami's work skills could have gotten any worse.

"And you have Tegan," Lynda went on, smiling.

"Um, yes. She's an excellent worker."

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"I'm sure she is, Michael." Lynda rolled her eyes. "Come on, I saw you kissing her at our wedding reception. So what's up? Are you two going out?"

"Well, maybe. Sort of."

"*Sort* of?"

I sighed. I was smitten with Tegan, no doubt about it, although a year ago I'd never have believed I could fall for a girl with spiked hair, tattoos, and snakes. But it was all damnably awkward, since she was an employee and I was her boss. I tried to explain this to Lynda, without notable success.

"Well, anyway," she said. "Happy birthday." She handed me the cardboard box.

It was a plain cardboard box, with a bow on top but with no wrapping paper. It had air holes. This was not a good sign.

"Come on, open it," Howard said.

I lifted the top and looked in. Inside were two little tortoises, each of them about the size of the palm of my hand.

"Er," I said. "Tortoises. For me?"

"For you," Howard said proudly. "Do you like them?"

I picked up one of the tortoises, looked at it, and tried to smile. Howard was looking anxious and hopeful, obviously eager for me to like my present. The little tortoise peered back at me and waved its legs in the air. A reptile. How nice. But at least it wasn't a snake.

"Well, sure," I said heartily. "They're great. Are they Max's kids?"

"Oh, yes." The huge old tortoise Max was one of Howard's favorite pets. "And here's the aquarium we got ready for you. It has the proper lights all set up in it, and a water bowl, and a place to climb, and a couple of little shelters for them to hide in. Lynda made the shelters, see?"

I looked into the aquarium. There were two little tortoise-houses, both made out of needlepoint. Ye gods.

"I kept thinking you ought to have a pet," Howard went on. He was starting to look worried. "And it seemed like tortoises would be just the thing, since you can leave them alone all day while you're working. That's why there's two of them, so they can keep each other company."

Howard really had meant well; I knew that. And I'd always pretended to like his reptiles, so how could he have known better? "Thank you, Howard," I said. "It's just the thing."

He brightened. "Really?"

"Really."

"Oh good, good. So, what are you going to name them?"

"Well, I don't know." I picked up the second tortoise, which looked exactly like the first one. How could I name them when I couldn't even tell them apart? "I'll have to think about it."

Howard nodded, looking pleased.

"By the way," I said, "I don't suppose you know anyone who would like a nice big snake?"

"A snake?" Howard looked interested.

"*How* big of a snake?" Lynda asked.

"Oh, I don't know. Six feet, seven. Well, maybe eight feet. Or nine. I haven't actually measured it."

"Honey, what do you think?" Howard asked.

"No," Lynda said firmly. "We're talking about a reptile brain here. It'll think anything smaller than it is food. And I might add, *I'm* smaller than it."

"Well, that's true," Howard conceded. "That is the problem, isn't it? It's so sad the way snakes get abandoned when they grow too large to handle. No one wants to be around them any more." He looked thoughtful. "Of course they do sometimes try to eat their owners, but it isn't like it's the snakes' fault. They aren't smart enough to know any better."

I had a sudden urge to go check and see if my snake was still in its too-small aquarium.

"I'll ask around," Howard said. "I know some people who do snake rescue. I'll see if they can take your little guy."

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"Thanks," I said, bemused. I hadn't known there was such a thing as a snake rescue group. "I'd appreciate that. So, how are you two getting along? How are the monsters?"

"Oh, they're fine," Howard said. "Still growing like mad. You won't recognize them the next time you come out. Would you, um, like to see some pictures? And would Tegan?"

I smiled and called Tegan into the room. Howard can be worse than a new father with baby pictures sometimes. He can't show the pictures to just anyone, though; he's firm about keeping his monsters a secret. He develops the pictures in his own home photo lab, and Lynda, Tegan, and I are the only ones who get to see them.

Howard unlocked his briefcase, shuffled through a pile of poetry books and notes (he teaches poetry three days a week at the local college), and pulled out a plain brown envelope. Proudly he handed it to me, and I shook the photographs out onto the exam table while Tegan peered over my shoulder.

The monsters *had* grown. A lot. They were starting to look more and more like their mother, who had died of a mysterious disease while they were still in the pouch. They were singularly peculiar creatures, with huge spherical bodies with four-pronged tails, wrinkly whiskered faces, and a respiratory system complete with blowholes *and* gills. I picked up a picture of Curious, the monster I knew the best, and examined it. The surgical scar on his bulbous side was fading nicely (*that* surgery had certainly been a nightmare) and it looked like it might disappear altogether one day. I handed the photo to Tegan and flipped through pictures of the other monsters—Caddy, Megamouth, and the rest—and then stopped at a photograph of a patch of muddy ground. You had to look closely to see the tiny silver fragments of eggshell in the mud.

"Oh look," Tegan said. "The hatched eggs. Have you ever seen what hatched out of the eggs?"

Howard shook his head regretfully. "No," he said. "We're keeping our eyes open, though."

Of course they didn't really know what to look for; sea monster reproduction was turning out to be more mysterious than their respiratory systems. I'd thought at first that the monsters were simple marsupials, that they gave birth to undeveloped live young which crawled into their mother's pouches like little kangaroos. After all, we'd found the ten baby monsters in their mother Nessie's pouch. They'd still been nursing, and Howard had had to bottle-feed them all.

But this winter, Caddy had laid a clutch of tiny silver eggs in the snow at the bank of their pool, and Megamouth had followed her out of the water to fertilize them. Two weeks later, Howard had found the shards of eggshell, and whatever had been inside the eggs had disappeared. There wasn't anything in any of the monsters' pouches; Howard had checked. Apparently this stage of the life cycle was free-living, and presumably at some future time, the hatchlings would find their way to their mother's pouch.

That was my guess, anyway. Reproduction can be a complicated thing. I looked at Tegan wistfully, and sighed.

There was a knock on the door; Howard hastily swept his sea monster pictures into his briefcase. Kami poked her head in and said, "Dr. Clayton? There's a chicken here to see you."

"Oh." I sighed again. "Thank you, Kami."

"We'd better be going," Howard said. "Let us know what you name the tortoises, OK?"

"Sure," I said. "See you."

Lynda waved, and together they headed out through the waiting room, passing by a woman who was sitting on a bench with a chicken on her knee.

"What a weird-looking chicken," Tegan whispered to me. "What kind is it?"

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It was a black chicken, with a huge topknot of feathers that fell forward and obscured its eyes and face. I had never seen anything quite like it before. "Um, some exotic breed," I said lamely, and changed the subject. "Tegan, would you get these tortoises set up in their aquarium for me?"

"Sure. Are they Professor Winston's?"

"No. They're, ah, mine. For my birthday."

"Your birthday? I didn't know it was your birthday." Tegan looked at me accusingly.

"I usually try to forget about my birthdays," I said. "I don't know how Howard found out."

"Hm," she said. "You're not on call tonight, are you? Want to come to my place for dinner?"

I suddenly felt happier. Maybe this birthday wasn't a lost cause after all. Dinner with Tegan! This was a present far more to my liking than a pair of tortoises. "Sure," I said. "I'd love to."

Midnight the exotic chicken had a laceration across the back of its head; it had been bitten by a toy poodle. It was a Polish chicken, its owner Mrs. Jones informed me, obviously taken aback by my ignorance of the breed. Apparently it had been bred for its plumage, which was, I had to admit, spectacular. But it was impractical at best, since apparently the chicken couldn't see well enough to avoid predators. Even very small predators.

"You'll need to set up a safe place for your chicken," I told Mrs. Jones as I sutured the wound. "Someplace where your dog can't get at it."

Mrs. Jones gave me a sideways look; she seemed unsure about taking advice from a vet who didn't know what sort of chicken she had, but eventually she conceded that a chicken sanctuary would be a good idea.

"It will be awkward, though," she said with a sigh. "Midnight and Buffy will have to take turns in the house."

A chicken in the *house?* "Oh," I said faintly. "I see. But if you don't keep them separated, this sort of thing is bound to happen again."

"I suppose you're right," Mrs. Jones said unhappily. "Well, there's no help for it. I'll see to it that they're separated." She looked thoughtful. "I suppose I could fence off half the house as well as half the yard. Then they could both be inside, yet still be in a safe environment."

"Um," I said. I hadn't had in mind anything quite so extensive.

But she was on a roll. "Yes, that's just the thing! It will solve everything. I'll see about hiring a contractor tomorrow."

I finished suturing the wound, then watched as Mrs. Jones carried her chicken out to her car and placed it in the passenger seat. Unreal. I went back to the exam room and found that Tegan had already finished scrubbing my instruments and was busy sweeping up chicken feathers.

"The treatments are all done," she said, "the back door is closed and locked, and I checked on the snake. I'll bring it something to eat tomorrow. Just in case. Are you about ready?"

"Sure."

"Why don't you take your tortoises home, then, and get them all comfy. Then come on over for dinner. Here, I made you a map."

She handed me a sheet of paper and I took it, belatedly remembering my tortoises. I had managed to forget all about them. What in the world was I going to do with them? Perhaps I could leave them at the clinic. But no, Howard would find out, and he'd be horrified that they weren't living at home with me. He'd be even more upset if I gave them away. Resigned, I went to fetch my new pets.

I drove home with the aquarium on the floorboard of the truck. The little tortoises crawled about busily; out of the corner of my eye I could see one of them scaling the little rock mountain

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that Howard had helpfully provided. I hadn't known that tortoises liked to climb. Distracted, I almost missed my turn. I wrenched at the wheel and took the turn on two squealing tires. When I was on the straightaway again, I saw that my little mountain climber was down on his back, legs waving in the air. Oh well. I was almost home. A few minutes later I pulled into the drive of my rented duplex, parked, and carried my tortoises inside.

Now, where to put them? The kitchen counter had a handy plug, but I didn't really want them in the kitchen. Hell, I really didn't want them in the *house*. Finally I settled on a corner of the living room floor. I set down the aquarium, plugged it in, and righted the overturned tortoise. It looked relieved, and immediately started up its mountain again.

The water dish had apparently suffered a tidal wave; I scooped up the soaked bedding and refilled the bowl. The food dish still had plenty of fruit and vegetables in it, which was a good thing, since my refrigerator contained only beer and hamburger. I was going to have to go shopping.

But not tonight. Tonight, dinner at Tegan's! I quickly glanced through my mail (lots of bills, as usual) and checked my messages. There was only one message, from my landlord. "Sorry to spring this on you, Michael," the message said cheerily, "but your lease is up next month, and we've decided to sell the duplex, so you'll have to be out by the end of next month. Sorry."

He certainly didn't *sound* sorry. Unhappily, I looked around the duplex. I wouldn't really miss the place, but moving was going to be a pain in the neck. Especially this time of year, which was the busy season at the clinic. When was I going to find the time to look for a new place, let alone move?

But this was no time to be worrying about next month's problems. I picked up Tegan's map and hurried out to my truck.

* * *

Tegan's apartment looked fairly normal from the outside. It was perched atop the detached garage of a big rambling house just outside of town. It was very picturesque, really, as the garage was nestled in a thick stand of piñon and juniper. I pulled my truck into the drive beside Tegan's battered little car, got out, and climbed the steps to her door. I knocked, and after a moment the door swung open.

"Hi!" Tegan said. "Come on in. How are your tortoises?"

"Oh, they're fine, thanks." I took a step inside, then stopped, startled by the riot of foliage just inside the doorway; it was a jungle of green leaves and vibrant blossoms. I took another step, and bumped my head on a hanging pot with a huge fern dangling over its sides.

"Oh, sorry," Tegan said. "You'll have to duck under that."

"Right. Thanks." I made my way further into the room. There were plants everywhere, hanging in pots from the ceiling, clustered in the windowsills, on top of the bookcases. The far side of the room contained a large homemade terrarium, complete with plants, little pools of water, tree branches and—I looked closer—lizards and snakes. A couple of crickets hopped about forlornly, seeming to realize that they would soon be reptile food.

"Dinner's almost ready," Tegan said. "Have a seat."

I made my way through the foliage to the kitchen table, which was set with two plates, silverware, and a potted violet. Tegan was busy at the stove. She'd changed from her work clothes into a leotard and skirt, and she looked stunning. I suddenly wished that I'd changed out of my work clothes too. Although, come to think of it, I didn't really have anything nicer to wear. All my clothes were pretty much the same.

Dinner was startlingly normal: salad and spaghetti, and for dessert a cupcake with a birthday candle stuck in the mid-

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dle. Tegan lit the candle, smiled, and said, "Make a wish." I looked at her face, aglow with candlelight, gazed into her beautiful brown eyes, and wished.

Immediately the phone rang. It was Howard, calling because something seemed to be wrong with his sea monsters. He wanted me to come out to his place right away.

Believe me, that wasn't what I wished for.

Howard's place is sixty miles outside of town, in the mountains at the end of Caliente Canyon. The roads are bad, especially when you get onto Howard's property, and sometimes the drive seems endless. I didn't mind it tonight, though, because Tegan was with me; she was fascinated by the monsters and took every opportunity to visit them.

"What did Howard say was wrong?" Tegan asked.

"He said the monsters were acting strange. He said he went up to see them this evening, and they just ignored him. Apparently they haven't ever done that before."

Tegan looked thoughtful. "That's a pretty vague symptom," she said.

"Tell me about it." In my experience, the sea monsters' symptoms were always vague.

"Do you think there's really anything wrong?"

"I've got no idea," I said. "Howard is really good about picking up on anything that's out of the ordinary with his pets. The problem is, we don't know enough about the monsters to know what *normal* is."

"Like when Caddy laid her eggs. She was acting so weird, we all thought she was sick."

"Exactly."

Tegan tucked her legs up on the seat and gazed out the window for a time. I turned expertly onto Howard's faint ranch road (I'd been there many, many times) and Tegan jumped out to open the gate. When she got back in, she brought with her a gust of cold air and the scent of juniper. For a moment I envied Howard, living in his idyllic hideaway up in the mountains. Then my truck hit the first of the road's many formidable potholes, and my duplex suddenly seemed a much nicer place. It was really too bad that I was going to have to move.

"Is it just me," Tegan said, "or is this road worse than it was last time we were here?"

"It's worse," I said. "Howard says it discourages trespassers."

"What does he do if he needs a plumber?"

"I don't know," I said. I'd never thought about that before. How *did* Howard handle home-repair problems?

Tegan looked pensive. "Do you think he'll always be able to keep the monsters a secret?"

The truck jounced into another pothole and lurched very close to the edge of the road, where a cliff face dropped away into the darkness. It didn't seem likely that anyone would stumble across the monsters by way of *this* road, but the dryness of the desert mountains was deceptive. There was a vast network of underground water beneath us, connected to the surface via a myriad of hidden pools, stock ponds, and springs. Howard had taught his monsters to stay within certain artificial boundaries, ensuring that they would not come to the surface anywhere off his property. But the monsters were growing up. Who knew if they might, like teenagers everywhere, decide to rebel against their boundaries?

"I don't know," I answered. "Howard won't ever reveal them; he's frightened of what might happen to them if they're discovered. But the monsters may have other ideas."

I thought about what might happen, should the scientific community (not to mention the media) ever find out about the monsters. There would be certain distinct advantages—turning over the

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monsters' veterinary care to an aquatic specialist came immediately to mind—but the idea still made me uneasy. I remembered all too well the time when all the little monsters had popped up in the middle of the Huntingdons' stock tank. I had only met the Huntingdons twice, but they had made a vivid impression. They would not have hesitated to kill the monsters. And even a fairly scrupulous scientist might see no great harm in sacrificing one of the monsters in order to study its internal anatomy; after all, there were nine more. And then there was Stranger, the even weirder creature that lived deep below the monsters' pool. As far as I knew, she was the only one of her kind.

When we got to the monsters' pool, Howard and Lynda were waiting for us. They'd rigged a light, much to my relief, and the near side of the pool was lit up almost as bright as day. Tegan and I got out of the truck and joined them by the pool.

"So what's going on?" I asked.

"I don't know," Howard said fretfully. "They're just acting so odd. Look at them."

I gazed out at the pool. It was an ordinary-looking stock pond, save for the unusual clearness of the water. The casual observer would never guess that there were hidden depths of waterways beneath it, or that there were monsters within it. The water remained quiet and still as I peered at it, my eyes slowly adjusting to the dimness outside the cone of Howard's light. Then there was a soft spray of water from a blowhole, and one of the monsters surfaced.

It was Curious, the most playful and fun-loving of the monsters; I'd know his wrinkled whiskery face anywhere. He always swam up to the bank to greet me, squeaking and whistling and extending a tentacled fin for me to hold. But today he simply glanced at me, scarcely acknowledging my presence, and then he sank slowly back beneath the surface.

"Is that what they're all doing?" I asked, bewildered.

Howard nodded mournfully.

"For how long?" I asked.

Lynda glanced at Howard, looking stricken. "We don't know," she said. "They seemed normal this morning, but we've been gone all day. We'd just gotten home when we called you."

As she spoke, Caddy and Megamouth appeared, swimming slowly towards the bank a few feet away from us. They hovered there, fins slowly churning the water, and a moment later Curious joined them. One by one the other seven appeared, all converging on a spot in the sandy shallows nearby.

I looked carefully at each monster in turn, trying to decide if there was anything abnormal about them besides their behavior. They were much bigger than the last time I'd seen them; they seemed to be nearly full-grown, and as far as I could tell, they all looked healthy. As I watched, Caddy and Megamouth crept slowly up the bank, coming to rest on the bottom with their blowholes in the air but with most of their bodies submerged. The other monsters hovered close by. With all ten of them visible, the stock pond looked oddly small. I knew how big it really was—I'd gone diving in it, and hadn't seen any sign of the bottom—but I still felt a twinge of concern. Was the pond really big enough for ten fully grown monsters?

Caddy suddenly let out a shrill whistle, and I jumped. All at once the monsters started to move, diving for the bottom and then resurfacing with rocks and sticks in their fins, squeaking and whistling nonstop as they deposited their finds in the shallows.

"What are they doing?" Howard asked. "Doc?"

I didn't answer; I had no idea what they were doing. All ten monsters swam back and forth in a frenzy, piling sticks and rocks and mud in a pile that slowly spread from the shallows to the bank. Except it wasn't a pile, not really. It was

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a semicircular partition which separated a portion of shallow water from the rest of the pond. As I watched, the partition walls rose above the waterline, and the monsters busied themselves plastering the walls with mud and piling on more flotsam. When the walls were tall and sturdy, the monsters seemed to relax. The frenzied swimming stopped, and the disturbed dirt and silt began to settle towards the bottom. Curious squeaked and swam over to us, pushing himself up half out of the water to greet us. Then he slid back into the pond and started playing half-heartedly with the smallest monster, Caterpillar. It seemed a token effort; they both looked exhausted.

I moved closer to the monsters' wall, marveling at it. I'd never known them to build anything before. Tegan leaned over to touch it, poking gingerly at the construction to test its strength. "It's like a beaver dam," she said. "What do you think it's for?"

"I've got no idea," I said. "Can you see anything in the little pool?"

"Not yet," she said. "Howard, can you move the light a bit? There, that's good. Wait a minute—I think I saw something move."

Howard and Lynda crouched down near Tegan, peering into the little partitioned pool. I was still watching the monsters. Curious and Caterpillar were dark shapes outside the circle of light, still playing their half-hearted game, and after a moment the others joined in. All but Caddy and Megamouth, who hovered near the partition, looking extremely pleased with themselves.

"Oh, I saw it," Lynda said, excited. "And there's another one; look!"

"What are they?" Howard asked. "Oh look, another one. And another. How many *are* there?"

I turned away from Caddy and Megamouth and joined the others. Howard's light was now positioned so that it shone directly into the little pool, and the water was regaining its usual clarity as the disturbed dirt settled. In the water I saw a group of little swimming creatures. Each was about two inches in diameter, shaped like a flattened sphere with eye-stalks. They were brown, speckled with gray and black splotches. And how many were there? I counted four, five, six. . . .

"Ten," Tegan said. "There're ten of them."

Ten? I looked back at the big monsters in the stock pond; there were ten of them as well. Were there always ten in a litter of sea monsters or was this a coincidence? Were these indeed the creatures that had hatched from Caddy's eggs? Judging by the way Caddy and Megamouth hovered nearby, they were. They didn't look like sea monsters, except for a certain wrinkly quality around their eye-stalks, but I was pretty sure that that was what they were.

"Are they the babies?" Howard asked eagerly. "They are, aren't they! Oh, look how adorable they are."

"They're beautiful," Lynda said proudly, and Tegan nodded in agreement.

I looked at the little creatures again. They still looked like wrinkled, flattened spheres with eyestalks. They cruised slowly about their pool, moving with awkward undulations of their bodies in the style of clumsy amoebas. They definitely weren't beautiful.

But they were sort of cute.

One of them was subtly changing color, the brown of its skin slowly changing to olive green. As I watched, the others started changing color too, some to olive green and some to a darker brown. Tegan lightly touched one on its back, and it instantly turned a brilliant red. All of the other creatures changed to a dull pink, with red spots. Startled, Tegan pulled her hand back out of the water.

"That's amazing," Lynda said. "I wonder if they communicate with each other that way. With colors and patterns, like octopi." Lynda looked excited; she had been trying to decipher the sea monsters' whistles and squeaks ever

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since they were tiny, and had gotten almost nowhere. If these creatures communicated with color, that would be a whole new avenue for her to explore.

"They feel different from the monsters," Tegan said thoughtfully. "I didn't get any sort of sense from touching them." In fact, that was the only way we'd been able to communicate with the monsters at all; when one of us clasped a monster's fin, there was a transmission of emotions—fear, contentment, happiness; a sort of chemical communication. I reached out to touch one of the pink and red-spotted creatures. It immediately broke out in more red spots, but didn't turn fully red as Tegan's had done. And Tegan was right; I didn't feel anything from it at all.

We sat by the pool for far too long that night. Howard made a trip back to the house to fetch snacks and a cooler of drinks, and after an hour or two, Howard and Tegan began to wax poetic. I found that it was almost as interesting to listen to them as it was to watch the baby monsters, even though I had never had the slightest interest in poetry in the past, and had always been grateful that Howard was not inclined to recite poetry around me. They traded poems titled "Evolution" for a time—I actually quite liked the one that began "When you were a tadpole and I was a fish,"—and then delved into Shakespeare.

"Oh, there's a perfect one," Tegan said. "'But doth suffer a sea-change, into something rich and strange.'" Even I had heard that one before, in my hated college English class. I had disliked Shakespeare with a passion. But tonight, in the moonlight, with the sea monsters and their astonishing babies swimming in the pool beside us, the bard's words seemed remarkable and true.

Or maybe it was just because Tegan was reciting them.

We watched for hours as the baby monsters swam beside us, changing through a rainbow of colors.

* * *

Four weeks later, I still hadn't named my tortoises. Hell, I still couldn't tell them apart. I was going to have to do something about that. Soon. Howard had been calling me every day to update me on the baby monsters and to ask me what I had named my tortoises. I reached into the aquarium, picked up both tortoises, and squinted at them. They looked like identical twins to me. How was I supposed to name them when I couldn't even tell which one was which?

Well, there was no help for it. I put one of the tortoises back in the aquarium, carried the other to my desk, and used a marker to paint a large black dot on the top of its shell.

The phone rang while I was capping the pen. I groaned, remembering that I was on call tonight, and picked up the phone. It wasn't an emergency, though; it was Howard.

"The babies are growing," he said proudly. "Lynda measured them today. On average they're about half an inch bigger than the first time we measured."

"Well, that sounds good," I said cautiously. Yes, growth seemed like a good thing, but who knew? "Have you figured out what they're eating?"

"Not really. They spend some of their time burrowed into the sand on the bottom, so I suppose they might be eating worms or bugs or something. And their colors are getting just amazing. Lynda's been by the pool every waking minute, logging the color changes and trying to figure out what they're responding to each time. We've got videos, too. Michael, you simply must come and see them in the daylight."

"I'll try to come out this weekend," I promised.

"Oh, good. Say, have you found a home for your snake yet?"

"No," I said shortly. The snake was still living in the storeroom, sated (I hoped) on the rat it had eaten last week. It was restless, though, and its aquarium was definitely too flimsy for it. Today I'd

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gone to the storeroom for a box of adhesive tape, and had found the aquarium empty and the snake tightly coiled around the mop bucket. I had not been pleased.

"Well, snake rescue hasn't got room for it, but I'll keep trying to find it a home. How are your tortoises?"

"Oh, they're fine. Just fine." I waited for the next question.

"Have you named them?"

"Well—" I realized that I still had one of the tortoises in my hand, the one that was marked with the large black spot. I held it up in front of me. I could tell it apart from the other one now, but I still didn't know what to name it. Speedy? Greenie? Inertia? It *was* a tortoise, after all.

"Spot," I said, suddenly struck with inspiration. "And—and Rover."

Howard laughed in delight. "Oh, that's good! See, I told you the names would come to you. See you this weekend."

After Howard hung up, I sat at the desk for a time, watching Spot navigate through my piled books and papers. Spot was quite an active little fellow; it was surprising how quickly a tortoise could travel. When he wandered too close to the edge of the desk, I scooped him up and put him back in the aquarium. He trundled to the food dish, which was full of healthy chopped vegetables and fruits. The grocery-store clerk had been wildly impressed that I was purchasing fruits and vegetables for a change. I'd decided not to mention that it was all going to be tortoise food.

Spot crawled into the dish (tortoises are not tidy eaters) and started munching something green and leafy. I watched him eat, wondering what the baby monsters were consuming. Since they were growing, they had to be eating *something*. If they really were growing, that is; I couldn't imagine that the little spheroids were easy to measure. Lynda might be mistaken. But I didn't really think so.

I finally stopped watching the tortoises and picked up the newspaper, ready for my nightly ritual of scanning the classifieds for rentals. I was going to have to leave my duplex in less than a week, and I still hadn't found anyplace to go. There simply wasn't much available. This week, for example, I had only found a six-bedroom estate (complete with sauna, stables, and a corresponding monthly rate), a summer cabin in Colorado, and a fixer-upper whose ad cheerily stated that they were planning to install plumbing "soon." None of these were exactly what I was looking for.

I started scanning today's ads—the cabin in Colorado had vanished from the classifieds, but the estate and the fixer-upper were still available—and saw a new listing. It was for a one-bedroom apartment, furnished, in a nice neighborhood only a few minutes from the clinic. The rent was reasonable, and it was available immediately. Saved! I thought gleefully. Eagerly I picked up the phone and dialed the number. A woman with a pretty voice answered it on the second ring.

"Hello," I said crisply, trying to sound like a well-financed, responsible tenant. "I'm inquiring about the apartment for rent. Is it still available?"

"Why yes, it is," the woman answered pleasantly. "It's a very nice little one-bedroom, furnished, with lots of windows. I could show it to you tomorrow if you'd like."

"That would be great," I said happily. "Let me see, my schedule's a little erratic, but would sometime around noon be OK?"

"Certainly," the woman said. "I'll just go ahead and go over our policies, shall I? They're all quite standard. The lease is for one year, we'll require first and last month's rent plus a security deposit up front, and we don't allow pets."

"Oh, that's no problem," I said, although coming up with that much money at one time was likely to be a large

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problem indeed. I'd figure something out, though. "I'll have all the deposits ready, and I don't have any pets. Well, of course there are the tortoises, but they live in a—"

"I'm sorry," she interrupted, her voice becoming frosty, "but we don't allow pets of any kind."

"But they live in an aquarium," I said. "They stay in it all the time. Wouldn't that be all right?"

"I'm afraid not," she said firmly. "Our policy is very strict. No pets of any kind. If you want to rent from us, you'll have to part with your tortoises."

"Oh," I said blankly. Why would a landlord care about a pet that lived in an aquarium? It wasn't like an aquarium inhabitant was going to be rampaging around the apartment destroying things. Well, unless it was my snake. But what harm could tortoises do?

"So do you still want to view the apartment tomorrow?" The woman's voice didn't sound pleasant any more.

I looked at Spot and Rover, who had finished eating and were presently resting in one of their little needlepoint shelters. I wasn't likely to come up with a better excuse for getting rid of them. Howard would probably even understand something like this. I opened my mouth to say yes, but then I looked at the tortoises again.

They *were* awfully cute.

"No, thank you," I heard myself say. "I'll keep on looking."

I hung up and stared at the phone. What was I thinking? There wasn't anyplace else to look. There were no other options in my price range, unless I wanted something without plumbing. I was going to have to leave the duplex in a matter of days. If I didn't take this apartment, I'd end up living at the clinic. I shuddered at the thought, and decided I had been too hasty. I was reaching for the phone again, phone number in hand, when it rang. This time it was an emergency.

I spent the rest of the evening, and most of the night, at the clinic. A German shepherd named Brutus had slipped out through a poorly latched gate and had wandered into the street, where he'd promptly been hit by a car. Judy, a cocker spaniel, had eaten a box of rat poison that had been stored in the garage. Fritz the dachshund had been attacked by the neighbor's Rottweiler. All in all, it was a long, long night.

When I finally drove home (at 5 AM) I was tired enough to be a bit philosophical. The world was a dangerous place, even if you were standing in your own front yard. (Little Fritz had been in *his* front yard when he was attacked.) I wondered how the monsters would fare over the long haul. There were plenty of dangers even when they stayed on Howard's property; there were poisonous creatures in the water (Curious had eaten one once, and had nearly died), there were diseases, there were parasites, and God only knew what other dangers lurked in the depths. It was no wonder the monsters had fenced off a relatively-safe area for their babies. I hoped it would work. Baby animals, just like children, tended to have most of their accidents in the home. Kittens got cycled through clothes-dryers and were crushed in reclining chairs; puppies chewed through electrical cords and swallowed toys whole. It was a wonder any of them survived to adulthood. Morbidly I wondered if the monsters' clever partition would be enough.

When I got home, I anxiously checked on Spot and Rover, and replaced their water dish with a shallower, broader bowl. Just in case they fell in.

I never did call back the woman with the one-bedroom apartment.

"So you still haven't found a place?" Tegan asked. It was Saturday, and we were driving out to Howard's place to visit the monsters. For once it was a pre-planned visit instead of an emergency.

"No," I replied.

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"When do you have to be out of the duplex?" she asked.

"Monday," I said mournfully.

"Where are you going to go?"

"The clinic, I guess. I can get one of those air mattresses and put it on the floor. Someplace."

"But what about all your stuff?"

"I don't have a lot of stuff. I guess it's just as well." In fact, I could still pack all of my possessions in my truck. At my age, I wasn't sure if that was such a good thing. Surely a mature, semi-successful veterinarian ought to at least need a U-haul to move his belongings.

"You can stay with me if you want," Tegan offered.

"Really?"

"Sure."

Oh, I was tempted, let me tell you. Pure spinal reflex almost made me say yes immediately. But as soon as my brain got into gear, I realized that I didn't want to do anything to spoil our slowly-developing relationship. We'd had only two real dates, so far, so it was probably a little too soon to be moving in. Besides, would there really be room for me among all those plants?

"It's nice of you to offer," I said. "But I'll be fine at the clinic."

"If you're sure," Tegan said doubtfully.

"I'm sure," I said, trying very hard to sound sure. After all, living at the clinic wouldn't really be so bad. There wasn't a shower, but there *was* plumbing, and I could take sponge-baths. An air mattress on the floor would, no doubt, be perfectly comfortable. It was even possible that there might be a quiet time in the middle of the night, when all the patients were resting and there was no howling or barking going on. Or maybe not. Well, there would definitely be plumbing.

We reached Howard's stock pond in the middle of the afternoon. It was a glorious spring day, full of bright sunshine and wildflowers and twittering small birds. Suddenly I felt like rejoicing: I was out of the office, I was with Tegan, and I wasn't on call. What did it matter that I had no place to live? Life didn't get much better than this.

I got out of the truck, stretched luxuriously, and wondered if it would be proper to hold Tegan's hand. I'd been trying very hard to keep our relationship professional while we were at work. But this wasn't work, not really. We weren't going to provide veterinary care for the monsters, we were just here for a friendly visit. Pleased with my analysis, I reached out hopefully, and Tegan smiled and put her hand in mine.

"Michael, Michael," Howard gasped, hurrying to meet us. "I'm so glad you're here. Something strange is happening."

Tegan let go of my hand, concern flaring over her face. Everything suddenly seemed dark and dismal again. Here I was getting kicked out of my duplex, with nowhere to go but a clinic with a huge hideous snake in it, and as if that weren't enough, I was going to have to deal with something *strange*. I had so wanted a peaceful, nonworking afternoon with Tegan.

"What is it?" I asked dolefully.

"It's the babies," Howard said. "They're, well—well, you'd better come and look."

Tegan and I headed for the pond, Howard jittering anxiously alongside us. The pond looked calm and peaceful: a gentle breeze was raising little ripples that glinted in the sunlight, and the banks were overhung with waving grasses and brilliant wildflowers. Lynda was sitting by the babies' pool, peering into it intently. In the stock pond Caddy surfaced with a little splash and whistled at us, and Curious squeaked happily and swam for the bank. Tegan paused to greet him, and I thought about doing the same, but Howard was already more nervous than a chihuahua on the exam table. I decided I'd better say hello to Curious after I'd had a look at the babies.

"Hi, Michael," Lynda said without looking up. She was sitting between a pile of notebooks and a box of brightly

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colored water toys, and she had a huge sheaf of paint samples in her lap. I settled on the bank beside her, and Howard picked up a video camera and hovered over us. In the partitioned pool, the little squashed spheroids undulated cheerfully through the clear water. In the daylight their colors truly were remarkable. I saw two purple ones with white stripes, a deep blue one with yellow eye-stalks, two sky-blue ones, and three speckled brown ones. The two purple ones peered at us, shifted briefly to a red-spotted pink (still with white stripes) and then slowly turned purple again. The blue ones bobbled past without seeming to notice us, and the brown ones crept slowly along the bottom. But wait, I'd only counted nine. Where was the tenth one?

"Look right there," Lynda said softly, pointing. "Against the partition."

I looked at the partition. It appeared to be even sturdier than the last time I'd seen it; I supposed that the monsters must have been periodically reinforcing it over the last few weeks. Carefully I examined the hard-packed network of twigs, grass, rocks, and mud. After a moment I saw an odd brown-speckled mass, which was clinging to the partition like a tumor. Its color was similar to that of the creatures that were crawling along the bottom of the pool, but it was definitely not an eye-stalked spheroid. It was more of an amorphous-looking blob.

I heard Tegan's soft step behind me, heard her indrawn breath. "What is that thing?" she asked.

"It's one of the babies," Lynda said. "It crawled up there a few hours ago, and then it stopped moving. It's been sitting there on the partition ever since. Changing."

"Like a caterpillar?" Tegan asked. "Is that a cocoon?"

"I think so," Lynda said. "What do you think, Michael?"

"Yes," Howard said anxiously. "What do you think, Doc? Is it all right for them to change like that? Are they supposed to?"

Well, *I* certainly had no idea. But the monsters were acting perfectly normal, playing tag in the stock pond, and *they* seemed to think that the cocoon-thing was OK. They'd always been very sensitive—if one of them was sick, then they all acted sick—and I figured that if anything were wrong with the babies, they wouldn't be playing. I said firmly, "Yes, I think this is what they're supposed to do. After all, they don't look much like monsters now, do they? They've got to change sometime."

"Oh," Howard said, sounding vastly relieved. "Oh, good; I was so afraid that something was wrong. Especially since it looks like those other little brown ones are headed that way."

I looked back down at the bottom of the pool. The three speckled brown spheroids were trundling very slowly across the bottom, all in the direction of the partition. They seemed to move more and more slowly as I watched, especially in contrast to the other six. The six bright-colored ones continued to swim here and there around the pool, changing colors as they interacted with each other. The sky-blue one bobbed near the two purple ones, and quickly changed to lavender. The blue-and-yellow one drifted near the cocoon, broke out in brown speckles, and then swam off, slowly resuming its original colors.

"Look at this," Lynda said. She took a plastic yellow ball out of the box beside her and tossed it into the pool. The blue-and-yellow spheroid bobbed to the surface beside the toy, goggled at it, and turned green. Lynda then tossed a red ball in beside it, and the spheroid developed a set of wavy black stripes. "They even react differently to very slight changes in color shades," Lynda said, pointing to her array of paint samples. "I keep wondering if they're actually communicating with color or just reacting to their environment, but I guess there won't be time to figure it out. Not if

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they're all going to start changing."

"I hope I've got enough pictures," Howard said behind us, his video camera whirring busily. "I was so disappointed that I didn't get a proper picture of the eggs."

I got up after a time and went to greet Curious (as always, he was happy to see me), and after he swam off to rejoin the tag-game, Caddy lumbered partway up onto the bank. She was a lot bigger than Curious, I noticed. So was Megamouth. I said hello to Caddy and took a handful of her tentacles, and a wave of emotion washed over me. I felt her pride and satisfaction, no doubt for the babies, mixed in with the simple pleasures of seeing friends and playing with her siblings. It wasn't language, perhaps, but it certainly was communication. I suspected the babies' color changes were something along the same lines, but simply harder for us to understand. It did look like they were all going to cocoon before we had time to find out, but I imagined that we could still learn a great deal from studying Howard's video logs. Knowing Howard, I was pretty sure that he had taken plenty of pictures.

We all spent the afternoon by the pond, basking in the sunshine and watching the babies. By the time the Sun set, the three brown babies had started to cocoon, and two of the others had gained brown speckles and had started crawling along the bottom. I had to admit that I was having a wonderful day, even though I was having to deal with *strange* in a big way. Strange was all right, I decided, as long as it was, well, normal.

As darkness fell, Howard turned the video camera over to Lynda, switched on the lights (he had four set up, now) and drove to the house to fetch sandwiches and drinks. By midnight, six of the babies had turned to cocoons, two were crawling the bottom, and two were still the same awkward undulating spheroids. Tegan and I had progressed to hand-holding.

Lynda sighed and stretched. "We ought to go in now," she said. "I usually don't keep the lights on them for so long, just in case they need the dark hours. Guess it's time to leave them alone for awhile."

Howard looked wistful, but he obediently turned off his camera and switched off the lights. "Gosh, it's late," he said. "Do you want to stay at the house tonight? You're not on call, are you? If you stayed here you could have a look at them in the morning."

"Well, I don't know," I said doubtfully. I didn't have any patients at the clinic this weekend, but what about Spot and Rover?

"We could stay as long as we left in the morning, couldn't we?" Tegan suggested. "My lizards should have plenty of food and water for the night. What about your tortoises, Michael?"

I'd given them a nice helping of fruit and vegetables this afternoon before I left, and had filled their water bowl. And it was midnight already; if we left at, say, eight in the morning, we'd be home by nine. The tortoises really ought to be fine until then. I fretted for a moment, worrying that one of them might tip onto its back while I was gone and be unable to get up. But then I remembered that as soon as I got home, I'd be going straight to bed, and wouldn't be able to turn them right side up till I woke up in the morning anyway. It wasn't like they would bark or cry when they got into trouble.

And I really did want to see what was going on with the monsters tomorrow.

"Spot and Rover should be OK too, as long as we head back in the morning," I said.

"Oh good," Howard said happily. "Let's go find someplace for you to sleep."

I spent the night on an air mattress in one of Howard's reptile rooms. (Tegan got the guest room.) The air mattress was much more comfortable than you'd

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expect, though there was something daunting about lying there listening to the soft slither of snakes and the pattering of lizard feet. A mournful cricket chirped for half the night, then abruptly fell silent. It had just become reptile food, no doubt. I was tired enough by then that I was simply glad it had stopped its racket.

I woke up at dawn, got dressed in yesterday's clothes, and set out for the kitchen. I got lost in the peculiar architecture of Howard's house (he'd built it himself) and found myself wandering past aquariums full of hermit crabs arranged next to mirrored display cases of pottery; terrariums of chameleons next to bookcases crammed with leather-bound books. The arrangement of displays was a reflection of Howard, I decided, although Lynda was starting to make a mark for herself—the pottery was hers. I wondered if I would ever have a place that reflected me. The duplex certainly didn't. I wasn't even sure what a place that reflected me would look like. Idly I wondered how I might decorate the six-bedroom mansion I'd seen for rent, if I should ever find myself in a position to afford it. How much would I have to raise the clinic prices in order to pay that exorbitant rent? Of course, if I raised the prices *that* much, I wouldn't have any clients left, which would mean there would be no income at all. Perhaps I could put a poster on the wall of the clinic storeroom instead.

After a hasty breakfast in the kitchen, we all headed out for the monsters' pool. There was only one baby left, a brown-speckled spheroid crawling across the bottom. We watched it (Howard, of course, filmed it) while it climbed onto the partition and made its cocoon next to the other nine. The little pool suddenly looked sad and empty. Howard put down his camera, looking stricken. Caddy splashed up onto the bank beside him, peering around the partition to examine the cocoons. Howard reached out to clasp her fin. Then she let out a cheerful-sounding squeak and slid back into the water of the main pond.

"Well, I guess everything's OK," Howard said. "It's just going to be so *strange* not having those babies swimming around. I already miss them."

It did seem strange, looking into the empty pool that had been full of bustling little spheroids just yesterday. What was happening inside those cocoons? What would emerge from them, and when?

And when had it started to seem strange to look at a pool that *didn't* have sea monsters in it?

Spot and Rover did fine during my overnight absence, and had no difficulty weathering either the move to the clinic or the subsequent move to the little apartment I finally found. In fact, they did a lot better than I did; living at the clinic for two weeks was not a pleasant experience, plumbing or no plumbing. It just wasn't restful, sleeping on the floor while a giant snake lurked in the next room. I had some interesting nightmares, all of which involved snakes.

My new apartment, while not exactly palatial, was a much more pleasant place to live. It even had furniture. I put Spot and Rover's aquarium on a little table under the bedroom window, unpacked my paltry number of boxes, and surveyed our new domain. I spent a few minutes rearranging the furniture, moving the bed a bit to the right and the chest of drawers a bit to the left. Then I peered out the window at the street below. It wasn't a great view, but it would do. Then I contemplated the bare walls. They really needed some sort of decoration, but what? I had a few extra posters at the clinic, but I didn't really want the Life Cycle of the Liver Fluke or the Anatomy of the Canine Ear on my bedroom wall. Well, I needed to go shopping for the clinic anyway; I was out of enemas. I would look and see what the store had to offer in the way of décor.

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At the store I wandered about the aisles, looking at the selection of framed prints, posters, and knickknacks. In the poster rack there was an astonishing selection of winged cherubs, unicorns, and rock stars I had never heard of. None of the posters was quite what I was looking for, although the poster of the blonde in Spandex and leather was certainly interesting. I studied it for a time, and then went off to buy my enemas. What *was* I looking for? I really had no idea.

I unloaded my enemas at the clinic, went back home, and spent the evening with Spot and Rover.

Two weeks later, in the middle of a hectic morning at the clinic, Howard called. He was so excited I could hardly understand him.

"They're out; they've come out and they've gone into Caddy's pouch, just like Nessie's; they look just like little sea monsters now! All ten of them, they're so wonderful, and they're in the pouch and they're nursing and all of them seem fine, and you must come and see them, Michael, you must!"

"That's wonderful, Howard!" I was delighted too, especially by the news that all of the monsters seemed fine. I didn't often get frantic phone calls from Howard saying that everything was *fine*.

"When are you coming, Michael; can you come right away? I can't wait for you to see them!"

I glanced at my treatment board; I still had to spay a Rottweiler, fix a tortoise's broken shell (it had been run over by a lawn mower), de-scent a ferret, and suture up a horse that had run through a fence. This was going to take a while, and I still had afternoon appointments, too. Much as I wanted to go see the monsters (and escape from the clinic) I supposed that if there wasn't anything wrong with them, I couldn't legitimately cancel all my appointments.

"I can't come till tonight," I told Howard. "I'm swamped here, and as long as everything's OK . . ."

"Oh, everything's fine! No problems at all, everything is wonderful; I wish you could come sooner but I'll see you tonight; have a great day, Michael!"

I figured it was going to be hard to have a great day when there was a ferret de-scent in the middle of it (there are very few surgeries I like less) but once that one was over, the day got better. The tortoise's shell repair went very smoothly (once I got over cringing at the thought of such an accident happening to Spot or Rover), the Rottweiler was cooperative, and it was always good to get to work on a horse. The horse in question was foolish and skittish, as one might expect from a horse that had run through a fence, but I enjoyed the suture job just the same. I spent so much time working with exotic creatures these days, I hardly ever got to do a good old-fashioned laceration repair on a horse.

I was almost finished with the afternoon appointments when a huge, long-haired, scruffy-bearded man walked into the waiting room and politely inquired about the free snake. He was one of Professor Winston's poetry students, he told me (though not in Tegan's class, it appeared), and he had always yearned to have a big snake. When I took him to the storeroom and showed him the snake, he looked deeply into its eyes and pronounced it beautiful.

"Is it really free?" he asked hopefully.

"Really," I assured him.

"Then may I take it? I'll give it a good home, I promise."

The man strode out with the snake draped across his broad shoulders, happily murmuring endearments to it. Tegan, Kami and I watched him go.

"Cool," Tegan said. "I knew there was a perfect home for that snake somewhere."

Tegan and I reached Howard's place at dusk. I rejoiced all the way there, utterly thrilled to be rid of the snake. I

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could put the aquarium away in the shed and stop buying rats, and the snake could not possibly have found a better home. I wondered what the man's next poem would be about, and if anyone had ever before written a sonnet to a snake.

My truck bounced up to the stock pond and Tegan and I jumped out. Howard and Lynda were waiting for us there, and all of the sea monsters were clustered near the bank. Caddy and Megamouth appeared to have grown even larger than the last time I'd seen them—they were both now at least as big as Nessie had been, and the stock pond looked correspondingly smaller. The pond already didn't seem big enough for ten adult monsters. What was going to happen when Caddy's babies grew up?

But this was no time to worry about the far future. Proudly, Howard reached into Caddy's pouch and drew out a squirming little monster. It was a perfect miniature of Caddy, with a bulbous body, a wrinkled face, and whiskers. Howard gently put it into my hands, and it squeaked softly and sucked at my fingers.

"All ten of them made it," Lynda said happily. "They're all in the pouch, and they seem to be fine."

Caddy came out onto the bank and nudged me gently, and I put the little monster back into her pouch with the other babies. Then Caddy nudged me again, and wrapped her tentacled fin around my hand. I blinked at her, suddenly recollecting my last day in the old duplex, when I'd been sealing up boxes and doing a bit of token cleaning before moving into the clinic. Then I remembered walking into my new apartment with Spot and Rover's aquarium under my arm, surveying our new domain and pronouncing it home. I was even going to make it *look* like home, one of these days.

Beside me, I heard Tegan's soft gasp. I let go of Caddy's fin and turned to look at her. She was crouched at the pond's bank, her hand on Megamouth's fin, her eyes wide, staring at nothing. Then Megamouth swam away, and Tegan took a slow step backwards, looking dazed.

"Tegan? What's wrong?"

"Nothing's wrong, it's just—I remembered something I hadn't thought about in ages."

"What did you remember?" Lynda asked. I noticed that she and Howard were both watching us intently.

"I remembered the day I left home. It was—it was a rough day." Her eyes were downcast, her face drawn and closed, but only for a moment. She brightened and said, "But then I remembered the day I found my apartment, and how I started to decorate it, and how perfect it was for me."

What happened the day you left home? I wanted to ask, but Tegan had already moved past that, and was her usual cheerful self again. I was so intent on Tegan that it took me a minute to realize that she'd had the same sort of memory as mine.

"Howard and I remembered moving in together," Lynda said softly. "Making a home for ourselves."

There was a quiet splash from the center of the pond, and then another, as Caddy and Megamouth dove beneath the surface. The other eight monsters squeaked and whistled for a time, and then dove after them. Slowly the ripples died away, and the pond grew still and silent.

"They're not *all* leaving, are they?" Howard said in alarm. Lynda took his arm and shook her head, but Howard didn't look reassured until Curious splashed to the surface with seven other monsters following behind him.

But Caddy and Megamouth never did come back.

Two weekends later, I stood in my bedroom beside the aquarium, frowning at my still-bare walls. Caddy and Megamouth had no doubt set up housekeeping by now, in a pond of their own, and

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I was still living in a generic apartment. Even Spot and Rover had new décor; I'd bought them another little mountain to climb on. But I still hadn't found anything for myself.

The doorbell rang, and I hurried to get the door. Tegan had promised to come over and help me shop this afternoon. But the person at the door wasn't Tegan; it was a doleful-looking postman with a cardboard box in his hands.

"Wouldn't fit in your mailbox," he told me, sounding indignant. "Here."

I took the box inside, closed the door behind me, and read the address label. It was from Howard and Lynda. Nervously I turned the box over, then over again. There were no air holes, no mysterious thumps or squeaks emanating from within it. It was probably safe to open it. I pulled out my pocketknife, cut the tape, and opened the box.

Nestled in several layers of bubble wrap, I found a framed picture. It wasn't a picture of the monsters, although their pond was in the background. It was a picture of Tegan and me, silhouetted against the sunset. Tegan was in profile, gazing at the pond, and her hand was clasped in mine. Carefully I lifted the picture out of the bubble wrap and placed it on the bedside table.

The doorbell rang, and I hurried to the door. It was Tegan this time.

"Hi!" she said when I opened the door. "Ready to go shopping? We've got to make this apartment of yours into a home."

"I'm ready," I said, and followed her out into the sunlight. But I had Spot and Rover and a framed picture at my bedside, and Tegan to come visiting and perhaps, one day, move in. Whatever we found to buy today would not really make much difference.

My apartment had already changed into a home.■

(EDITOR'S NOTE: Michael, Howard, and the monsters have appeared previously in "Little Monsters" [November 1989], "Business as Usual" [July 1991], "Strange Things" [June 1992], "Yellow and Orange Blues" [May 1998], and "As Time Goes By' [July/August 1999].)

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Is such a thing possible?
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Galactic Society

Robert Zubrin

Two thousand years ago, the Roman philosopher Metrodorus, in contemplating the question of life in the Universe, asked; "Is it reasonable to suppose that in a large field, that only one shaft of wheat should grow, and in an infinite Universe, to have only one living world?" The question is well put.

We now know that the Universe is a fertile field. The possibility that this could be the case was suspected by some, such as the Italian Renaissance humanist Giordarno Bruno, who guessed the existence of other solar systems, even before the telescope revealed the stars to be suns like our own. Until the present decade it was still possible for pedants to argue that our planetary system could be a unique phenomenon, as no others had been observed. However, during the 1990s, over a dozen extra-solar planetary systems have been detected, thereby proving not merely the existence of these particular planets, but the fact that the processes that lead to the formation of solar systems must be common, and probably intrinsic to the process of star formation itself. Much more could be said on this subject, but suffice to say that, on the basis of current scientific knowledge, it's an excellent bet that the large majority of stars have planets.

We now have fossil evidence for life on Earth going back 3.8 billion years—practically to the time immediately following the conclusion of the early solar system's massive meteorite bombardments when life first *could* have existed here. The recent discovery of evidence of possible past life on Mars—dating back 3.5 billion years—gives additional strong support to the contention that the development of life on planets is a common event. Furthermore, the entire history of life on Earth shows clearly that, once life starts, it exhibits a continual tendency toward development of greater complexity, activity, and intelli-

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gence. In other words, based on everything that we know, life and intelligence should be common in the Universe. If we add to this the fact that, even at our relatively primitive level of technology, we today can conceive of how interstellar voyages can be performed with currently understood (if not yet practiced) engineering, and then consider the evolutionary advantages accruing to any species which engages in such voyages, the conclusion becomes inescapable: Our galaxy is almost certainly currently inhabited by large numbers of starfaring species.

When we go out among the stars, we may meet them.

Where are they?

There are 400 billion stars in our galaxy, and it's been around for 10 billion years. Even adopting the most pessimistic assumptions, it would appear obvious that numerous starfaring civilizations should have already appeared. Our galaxy is 100,000 light years in diameter. If an advanced civilization were to adopt an expansion program and move out at 0.5 percent of the speed of light, it would take at most 20 million years to occupy the whole place. As long as this might seem, it is only 0.2 percent the age of the galaxy. In other words, by rights, extraterrestrials should already be here! It was a calculation of this sort that led the great physicist Enrico Fermi to pose his celebrated question at a 1950 Los Alamos National Lab lunchtime meeting; if all that is so, then "Where are they?"

This question is known as the "Fermi Paradox."

In 1961, radio astronomer Frank Drake developed a pedagogy for analyzing the question of the frequency of extraterrestrial civilizations. According to Drake, in steady state, the rate at which new civilizations form should equal the rate at which they pass away, and therefore we can write:

$$\text{rate of demise} = N/L = R_* f_p n_e f_l f_i f_c = \text{rate of formation} \quad (1)$$

Equation (1) is therefore known as the "Drake Equation." In it, N is the number of technological civilizations in our galaxy, and L is the average lifetime of a technological civilization, so the left-hand side term, N/L, is the rate at which such civilizations are disappearing from the galaxy. On the right-hand side, we have R_*, the rate of star formation in our galaxy; f_p, the fraction of these stars that have planetary systems; n_e, the mean number of planets in each system that have environments favorable to life; f_l the fraction of these that actually developed life; f_i the fraction of these that evolved intelligent species; and f_c the fraction of intelligent species that developed sufficient technology for interstellar communication. (In other words, the Drake equation defines a "civilization" as a species possessing radiotelescopes. By this definition, civilization did not appear on Earth until the 1930s.)

Well, N, the number of civilizations, is a quantity of great interest, and so some people have attempted to use the Drake equation to compute it. For example, if we estimate L=50,000 years (ten times recorded history), $R_* = 10$ stars per year, $f_p = 0.5$, and each of the other four factors n_e, f_l, f_i, and f_c equal to 0.2, we would calculate that the total number of technological civilizations in our galaxy, N, equals 400.

Four hundred civilizations in our galaxy may seem like a lot, but scattered among the Milky Way's 400 billion stars, it would represent a very tiny fraction: just one in a billion, to be precise. A million stars can be found within a sphere with a radius of 430 light years surrounding the Sun, with the number increasing as the cube of the distance increases. If the calculation in the previous paragraph were correct, it would therefore indicate that the nearest extraterrestrial civilization is likely to

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be about 4,300 light years away.

But Drake developed his equation only as a pedagogical tool for delineating various factors influencing the probable frequency of extraterrestrial intelligence. He never intended his equation to be used as a computational tool, and if used as such, it is patently incorrect. For example, the equation assumes that life, intelligence, and civilization can only evolve in a given solar system *once*. This is manifestly untrue. Stars evolve on a time scale of billions of years, species of millions of years, and civilizations thousands of years. Current human civilization could knock itself out with a thermonuclear war, but unless humanity drove itself into complete extinction, there is little doubt that 1,000 years later global civilization would be fully reestablished. An asteroidal impact on the scale of the K-T event that eliminated the dinosaurs might well wipe out humanity completely. But five million years after the K-T impact, the biosphere had fully recovered and was sporting the early Cenozoic's promising array of novel mammals, birds, and reptiles. Similarly, five million years after a K-T class event drove humanity and most of the other land species to extinction, the world would be repopulated with new species, probably including many types of advanced mammals descended from current nocturnal or aquatic varieties. Human ancestors 30 million years ago were no more intelligent than otters. It is unlikely that the biosphere would require significantly longer than that to recreate our capabilities in a new species. This is much faster than the four billion years required by nature to produce a brand-new biosphere in a new solar system.

Panspermia

The Drake equation also ignores the possibility that both life and civilization might propagate across interstellar space. At the turn of the century, the Swedish chemist Svante Arrhenius proposed the theory that life on Earth may have originated from bacterial spores transported through space by light pressure. This theory, known as *panspermia*, was later championed by British astronomer Fred Hoyle, but became unfashionable after Hoyle's stock went down with the refutation of his "Steady State" cosmological theory by Big Bang advocates in the 1960s. However, the recent discovery of possible bacterial traces in ancient Martian meteorites has caused it to be re-examined.

As well it should—recovery of live bacteria (of terrestrial origin) from Surveyor spacecraft cameras left on the Moon has proven without doubt that bacteria can survive in the hard vacuum of space, and—provided a few microns of dust or ice are available as shielding—the cosmic ultraviolet environment as well. Bacteria are also terrifically radiation-resistant—it takes over 10 million rads to completely sterilize a culture of *Micrococcus radiodurans*, for example. By contrast, 1,000 rads will kill a human. Spores of bacteria have been recovered from amber and Permian salt deposits, and revived to life after periods of dormancy of 90 and 230 million years, respectively. In other words, bacteria, which appeared on our planet almost as soon as it was habitable for them, possess all the adaptations required for surviving spaceflight. Think about that for a minute: life frequently preserves unnecessary adaptations, but it never goes out of its way to create them. If bacteria originated indigenously in the clement ponds and oceans of Earth, why are they adapted to survive the hard vacuum, the temperature extremes, the radiation, and the extended periods of dormancy required for interstellar space flight?

If paleontologists were to discover that early inhabitants of some island had vestiges of marine adaptations, would they not conclude that they came from the sea?

How could bacteria develop adaptations for spaceflight? There are only two

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possibilities—natural selection or design.

Let's consider the most conservative explanation: natural selection of microorganisms originating on Earth. Suppose that on the early Earth, many types of microbes developed, and a few of these, by chance, possessed characteristics that would allow them to survive spaceflight. The early Earth was subject to massive, frequent asteroidal impacts, up to and including the world-shattering projectile that created the Moon. These impacts were so bad that many of them may have completely sterilized the planet, but in the process, kicked debris containing microorganisms into space. This debris would then orbit about the solar system for thousands and millions of years, until some of it re-encountered the Earth. However, the only microbes that would survive the trip, and thus live to recolonize the Earth with life, would be those which chance had preadapted for space. Their descendants, though, would share their astronautical capabilities.

But if this could have happened on Earth, then it could have happened on other planets. And there are likely billions of other planets where it could have happened first, and therefore, in all probability, did.

An alternative speculation is that bacteria were created by design, by an intelligent species somewhere interested in propagating life through the cosmos. In other words, bacteria *are* nanorobots. If we had nanorobots, one suggestion for their use might be to send them to other solar systems and then reconstruct people, thereby allowing us to colonize without spending the huge amounts of energy required to transport humans across interstellar space. But humans as we know them might not be properly adapted to live in the environment of the destination planets. A more flexible approach might be to send bacteria, perhaps with an implicit code written into their genetic structure determining that eventually they would evolve toward intelligence, but allowing them the flexibility to develop an array of plant, animal, and sentient species appropriate for the new world. The mentality that would conceive of such a program would have to take a much vaster and long-term view of things than we do, but perhaps that is what real intelligence is. If so, then our species has a long way to go to reach such maturity.

It would be interesting if microbiologists could conceive of some test that would allow us to determine whether the natural or nanotechnological explanation for the origin of spacefaring bacteria is correct.

The theory of panspermia is intrinsically unsatisfying to investigators of the origin of life, because it basically ducks the fundamental question of how nonliving matter complexified itself into the first cells. As an answer to the mystery of the origin of life, it's virtually worthless—it just moves the problem elsewhere. But for an investigation into the probable frequency of life, it is fundamental. In fact, even if somehow panspermia was not operative 3.8 billion years ago when life appeared on our planet, it is almost certainly underway now—originating, if nowhere else, from the Earth! For the past 3.8 billion years, every significant asteroidal impact into our planet has spewed debris loaded with microorganisms into interplanetary space. Once in space, light pressure from the Sun and gravity assists from close encounters with various planets has propelled innumerable numbers of these spores out of our solar system in every direction. Traveling at characteristic speeds on the order of 30 km/s (the Earth's velocity about the Sun), they could reach nearby stars in 50,000 years, during which time the bacteria would receive a cosmic ray dose of about one million rads—considerably less than the 10 million rads required to kill them. As they spread, each new planet colonized would become a

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source point for additional propagation. In about a billion years, they could colonize the entire galaxy.

The first life on Earth were bacteria, and all subsequent life here evolved from them. Despite hundreds of years of searching by many investigators, no evidence for the past or present existence on Earth of any form of free-living life more primitive than bacteria has ever been found. That's a very important fact, because bacteria, as simple as they are in comparison to multicelled plants and animals, are actually incredibly complex—clearly much too complex to be the first life to emerge from chemistry. Thus since no evolutionary history of the predecessors of bacteria can be found on Earth, it becomes increasingly likely that they originated elsewhere.

In that light, it is not surprising that the Earth's first inhabitants were capable of surviving spaceflight. Quite the contrary, logically it would be expected that the first species anywhere in the galaxy that evolved adaptations for spaceflight would become the basis for life nearly everywhere else.

Bacteria are everywhere. That means that nearly every planet whose prebiotic environment was acceptable to bacteria probably developed a biosphere. Once a biosphere develops to a certain point, it becomes capable of contributing to the regulation of planetary conditions through various forms of feedback (e.g. if a planet gets too hot and CO_2-rich, for example, plant activity accelerates, reducing CO_2 greenhousing activity and cooling the surface through water evapotranspiration from increased leaf area, etc.). By taking control of a planet in this way, a biosphere increases its chances for long-term survival, during which time it can evolve ever more complex species capable of greater degrees of activity, and therefore promote further expansion of the biosphere from oceans to land, to arid, torrid, and frigid regions, to mountains, and ultimately multiply it by colonizing new and previously uninhabitable planets across space.

In short, by ignoring the capability of both microorganisms and intelligent life to propagate across interstellar distances, as well as the capability of life to regenerate intelligence within a planetary system many times within the life of that system, the Drake equation drastically underestimates the probable frequency of life and civilization in the galaxy. So let's reconsider the question.

Calculating the Galactic Population

There are 400 billion stars in our galaxy, and about 10 percent of them are good G and K type stars which are not part of multiple stellar systems (with Ks outnumbering Gs by about five to one). Almost all of these probably have planets, and it's a fair guess that 10 percent of these planetary systems feature a world with an active biosphere, probably half of which have been living and evolving for as long as the Earth. So that leaves us with two billion active, well-developed biospheres filled with complex plants and animals, capable of generating technological species on time scales of somewhere between 10 and 40 million years. As a middle value, let's choose 20 million years as the "regeneration time," t_r. Then we have;

$$\text{rate of demise} = N/L = n_s f_g f_b f_m / t_r = n_b / t_r = \text{rate of creation} \quad (2)$$

where N and L are defined as in the Drake equation, n_s is the number of stars in the galaxy (400 billion), f_g is the fraction of them that are "good" (single G and K) type stars (about 0.1), f_b is the fraction of those with planets with active biospheres (we estimate 0.1), f_m is the fraction of those biospheres that are "mature" (estimate 0.5), and n_b, the product of these last four factors, is the number of active mature biospheres in the galaxy.

If we stick with our previous estimate that the lifetime, L, of an average tech-

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nological civilization is 50,000 years, and plug in the rest of the above numbers, equation (2) says that there are probably about *five million* technological civilizations active in the galaxy right now. That's a lot more than suggested by the Drake equation; it indicates that one out of every 80,000 stars warms the home world of a technological society. Given the local density of stars in our own region of the galaxy, this implies that the nearest *center* of extraterrestrial civilization could be expected at a distance of about 185 light years.

But in my view, technological civilizations, if they last any time at all, will become starfaring. In our own case (and our own case is the only basis we have for most of these estimations), the gap between development of radiotelescopes and the achievement of interstellar flight is unlikely to span more than a couple of centuries, which is insignificant when measured against L=50,000 years. So once a civilization gets started, it's likely to spread. Based upon our current knowledge of physics, fusion propulsion systems capable of generating spacecraft velocities on the order of 5 percent the speed of light appear possible. However, interstellar colonists will probably target nearby stars, with further colonization efforts originating in the frontier stellar systems once civilization becomes sufficiently well established there to launch such expeditions. In our own region of the galaxy, the typical distance between stars is six or seven light-years. So, if we guess that it might take 1,000 years to consolidate and develop a new stellar system to the point where it is ready to launch missions of its own, this would suggest that the speed at which a settlement wave spreads through the galaxy might be on the order of 0.5 percent the speed of light. However, the period of expansion of a civilization is not necessarily the same as the lifetime of the civilization; it can't be more, and it could be considerably less. If we assume that the expansion period might be half the lifetime, then the *average* rate of expansion, V, would be half the speed of the settlement wave, or 0.25 percent the speed of light.

We have assumed that the average lifespan, L, of a technological species is 50,000 years, and if that is true, then the average age of one is half of this, or 25,000 years. If a typical civilization has been spreading out at the above estimated rate for this amount of time, the radius of its settlement zone would be 62.5 light years (VL/2 = 62.5 ly), and its domain would include about 3,000 stars. If we multiply this domain size by the number of expected civilizations calculated above, we find that about 15 billion stars, or 3.75 percent of the galactic population, would be expected to lie within somebody's sphere of influence. If 10 percent of these are actually settled, this implies that there are about 1.5 billion civilized stellar systems within our galaxy. Furthermore, we find that the nearest *outpost* of extraterrestrial civilization could be expected at a distance of 185-62.5 = 122.5 light years.

The above calculation represents my best guess as to the shape of things, but there's obviously a lot of uncertainty in the calculation. The biggest uncertainty revolves around the value of L; we have very little data to estimate this number and the value we pick for it strongly influences the results of the calculation. The value of V is also rather uncertain, although less so than L, as engineering knowledge can provide some guide. In Table 1 we show how the answers might change if we take alternative values for L and V, while keeping the other assumptions we have adopted constant.

In Table 1, N is the number of technological civilizations in the galaxy (5 million in the previous calculation), C is the number of stellar systems that some civilization has settled (1.5 billion, above), R is the radius of a typical domain (62.5 ly above), S is the separation distance between the centers of civilization (185 ly

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Table 1. The Number and Distributions of Galactic Civilizations

	V=0.005 c	V=0.0025 c	V=0.001 c
L=10,000 years			
N (# civilizations)	1 million	1 million	1 million
C (# civilized stars)	19.5 million	2.4 million	1 million
R (radius of domain)	25 ly	12.5 ly	5 ly
S (separation between civilizations)	316 ly	316 ly	316 ly
D (distance to nearest outpost)	291 ly	304	311 ly
F (fraction of stars within domains)	0.048%	0.006%	0.0025%
L=50,000 years			
N (# civilizations)	5 million	5 million	5 million
C (# civilized stars)	12 billion	1.5 billion	98 million
R (radius of domain)	125 ly	62.5 ly	25 ly
S (separation between civilizations)	185 ly	185 ly	185 ly
D (distance to nearest outpost)	60 ly	122.5 ly	160 ly
F (fraction of stars within domains)	30%	3.75%	0.245%
L=200,000 years			
N (# civilizations)	20 million	20 million	20 million
C (# civilized stars)	40 billion	40 billion	18 billion
R (radius of domain)	500 ly	250 ly	100 ly
S (separation between civilizations)	131 ly	131 ly	131 ly
D (distance to nearest outpost)	0 ly	0 ly	31 ly
F (fraction of stars within domains)	100%	100%	44%

above), D is the probable distance to the nearest extraterrestrial outpost (122.5 ly, above), and F is the fraction of the stars in the galaxy that are within someone's sphere of influence (3.75% above).

Examining the numbers in Table 1, we can see how the value of L completely dominates our picture of the galaxy. If L is "short" (10,000 years or less), then interstellar civilizations are few and far between, and direct contact would almost never occur. If L is "medium" (~50,000 years), then the radius of domains is likely to be smaller then the distance between civilizations, but not much smaller, and so contact could be expected to happen occasionally (remember, L, V, and S are *averages;* particular civilizations in various localities could vary in their values for these quantities). If L is large (> 200,000 years), then civilizations are closely packed, and contact should occur frequently. (These relationships between L and the density of civilizations apply in our region of the galaxy. In the core, stars are packed tighter, so smaller values of L are needed to produce the same "packing fraction," but the same general trends apply.)

The Limits of L

It may be asked, why should L have any limits? After all, while a Type I (planetary) civilization can be wiped out by an asteroid or an epidemic, and a Type II (solar system) civilization could be eliminated by an interplanetary war or having its star go nova, what could possibly destroy a Type III (interstellar) civilization once it has expanded to 50 light years or so and colonized several hundred stars?

I can think of several things. One would be another Type III civilization. Another would be bad ideas.

The scientist Richard Dawkins has

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postulated a theory that views ideas, like genes, as self-interested entities dedicated to the purpose of furthering their own reproduction. An idea, or *meme*, as he calls it, spreads when it has appropriate features for infecting minds, which will then give it hosts and more bases from which to venture forth to infect other minds. Those memes best styled for rapid reproduction crowd out the slower ones, and therefore come to predominate. Memes may be useful ideas, and therefore spread because they are valuable to their hosts (i.e., intelligent organisms like us). But usefulness or truth is not a criterion for the spread of a meme—just capability to penetrate the brains of their hosts and then reproduce. And clearly, some memes can be pathological.

If we look at human history, we can see that most of our worst catastrophes were caused by bad memes which spread like contagions. Such mental diseases have included the messianic nihilism of the Mongol Horde; Muslim fundamentalism, which destroyed the potential of medieval Islam as a major world civilization; many other types of fundamentalism; the Pol Pot madness; and Nazism, which nearly led to the autocannibalization of European civilization within the past century.

One bad meme can wreck a society. And memes can spread by radio. A hundred-planet interstellar empire built over 50 millennia can be destroyed in 50 years by a radio-transmitted cult spreading at the speed of light.

In order to have had time to grow in the first place, a society must have significant internal resistance to bad memes. But complete bulletproofing is impossible, as intelligence and civilization themselves by their very nature require the ability to develop, assimilate, and spread new ideas.

And new ideas will be generated, because conditions will change. To take one obvious example, as the frontier of a civilization radiates outward into space, the interior worlds of a domain, which will constitute an ever-greater majority of the whole, will have no physical frontier of their own. They will no longer be able to launch missions to new and virgin stars, but must content themselves with the challenge of developing the interior. For how long will this be sufficient to prevent stagnation and the ensuing establishment of pathological forms of social organization with their concurrent deadly spreading pathological memes? It's impossible to say, but clearly the potential exists, and given sufficient time, anything that can happen, will. Sooner or later the ax must fall, thereby putting a finite limit to L.

A third factor that may put a boundary on L is biological evolution. We tend to think of ourselves as permanent, but *Homo sapiens* has only been around for 200,000 years, and there is no reason to believe that evolution has stopped. Quite the contrary, as humans gain control of their genome and move into novel environments in space, there is every reason to believe that evolution will accelerate dramatically. We will become something else, probably many new somethings else. The same would hold true for other species that master the scientific method, with its accompanying gifts of genetic knowledge and spaceflight technology. Everyone will change, and it is unclear whether the beings we change into will require or desire the continuation of interstellar expansion or even technological civilization itself. Could a species which has created for itself an ideal environment then degenerate into a group of lotus-eaters, needless of effort or thought? Might such beings then prove helpless to stop their own extinction when conditions changed? It does not seem impossible. Certainly we see many parallels to such cycles of heroic age, golden age, and collapse in human history.

So, one way or another, even the grandest of interstellar empires must

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come to an end. We know L is finite; if it wasn't, the Earth and every other planet would be crawling with aliens. But the human race has already existed for 200,000 years, and so L values on this order seem entirely possible. If that is the case, then the nearest extraterrestrial outposts could be quite nearby. If L is smaller, we may have a fair range of open space. But either way, one thing seems rather certain:

They're out there. Plenty of them.

The Search for Extraterrestrial Intelligence

The finitude of L thus provides one kind of answer to Fermi's Paradox. They are not here because they are not yet everywhere. But we are still left with the very interesting literal question: Where are they?

The first practical proposal to try to detect extraterrestrial civilizations at interstellar distances was advanced by Cornell physicists Giuseppe Cocconi and Phillip Morrison in 1959. In a calculation published in the prestigious science journal *Nature*, Cocconi and Morrison pointed out that existing radiotelescopes were capable of projecting a signal that could be detected by similar gear nearly at the distance to Alpha Centauri. Better equipment, already on the horizon (and which we possess today) could communicate much farther. Thus, while interstellar travel might require speculative advanced technology, interstellar communication did not, and therefore might well be underway, and therefore detectable, in the radio bands.

Of course, when listening for radio signals, one must know what frequency to tune in on, as there are millions possible. Cocconi and Morrison argued that the frequency of choice for interstellar communication would be near 1420 MHz (21 cm wavelength) as the emissions of hydrogen gas at that frequency make it the most important and most listened-to band in radio astronomy.

This latter argument has some logic, although to me it has always seemed a bit like, "We have a hammer, therefore this must be a nail." ("Our radiotelescopes are tuned in on 1420 MHz, therefore that is where ET must be signaling.") In the late 1950s and early 1960s, frequencies near 1420 MHz (L band and S band) were popular for spacecraft communication, and this gave added credence to the idea. However, since that time, we have already gone to higher frequencies that support higher data rates, which suggests that the idea of 1420 MHz as a universal communication band for advanced civilizations may be considered a form of temporal chauvinism, much like nineteenth-century astronomers trying to detect life on Mars by searching for the tell-tale emissions of Martian gaslights.

However, whatever its weaknesses, the Cocconi-Morrison suggestion represented a clear and *implementable* strategy for attempting the detection of extraterrestrials. In 1960, Frank Drake, then a young post-doc staff member at the National Radio Astronomy Observatory (NRAO) in Green Bank, West Virginia, decided to put it to the test. In an experiment called "Project Ozma," Drake pointed the Green Bank 26-meter-diameter radio dish at Tau Ceti and Epsilon Eridani, two nearby "good" G and K (respectively) type stars, and searched the radio waves around 1420 MHz for signs of intelligent communication. Except for a false alarm caused by a signal from a high-altitude military aircraft, the results of the search were nil. Nevertheless, the Ozma experiment caused a sensation, and over the years that followed, numerous other investigators with better equipment and more observatory time have greatly expanded upon Drake's work.

In addition to innumerable informal efforts by radio astronomers with some extra instrument time on their hands, these follow-up Search for Extraterrestrial Intelligence (SETI) activities have in-

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cluded the Big Ear program, run at Ohio State University from 1973 to 1998; the META and BETA programs sponsored by the Planetary Society (currently operating from Argentina and Massachusetts, respectively); and the SERENDIP and SETI Australia programs, which piggyback special SETI signal analyzers on whatever is being observed by the powerful Arecibo, Puerto Rico (300-m-diameter) and Parkes, New South Wales (94-m-diameter) radiotelescopes, respectively. The most powerful current SETI search is Project Phoenix funded by the SETI Institute (now headed by Frank Drake) with private money after the U.S. Congress killed the program's budget.

In his 1960 search for radio signals from Tau Ceti and Epsilon Eridani, Drake had a motor turn the radio dial to examine one frequency at a time. Thus only a few frequencies out of the hundreds of millions possible near 1420 MHz were briefly examined. In contrast, Phoenix, which is scheduled to study the thousand nearest-sunlike stars, can listen to 28 million channels at once. In the course of a day, Phoenix points Green Bank's 43-meter-diameter radio telescope at a given star and listens successively to one block of 28 million channels after another for five or ten minutes at a time. At day's end, two billion frequencies between 1000 and 3000 MHz have been studied. Then the next star is studied the same way, then the next, then the next. All told, it is estimated that the Phoenix study is 100 trillion times as comprehensive as Drake's original Project Ozma.

However, despite the improved equipment, all SETI searches conducted to date have been completely unsuccessful.

Now there are many possible reasons for the lack of success. For example, even the Phoenix only looks at a given star for a few minutes in a given frequency. Planets rotate. What if at the particular moment Phoenix is looking at an *inhabited* planet in the *correct* frequency, ET's radio transmitter is (or rather was) pointed in the wrong direction? We'd miss the show. We could be failing simply because the search is not intensive enough, with too little time devoted to each star of interest.

An alternative explanation for the failure is technological. The Cocconi-Morrison 1420 MHz recommendation that still focuses most SETI work was convenient to radio astronomers and appeared to have some validity since it mirrored technology that was then state-of-the-art for spacecraft communication. But even 40 years into the Space Age, such frequencies are already obsolescent. The amount of data that a spacecraft can send with an antenna and power of a given size is proportional to the square of the frequency. Thus the 8418 MHz (3.5 cm) X-band radios in common use on interplanetary spacecraft today can support a data rate 35 times greater than equivalent systems transmitting at 1420 MHz (L band). Using radio in the millimeter region could push the data rate up by another factor of a thousand, while going to optical frequencies (e.g. laser communication at 0.5 microns) would raise it millions of times higher still. The advantage of using these technologies for interstellar communication is shown in Table 2, where we compare the data rate possible for each, assuming a 10-MW transmitter and a target receiver at a distance of 10 light years.

Examining Table 2, it should be apparent why the assumption that extraterrestrials will choose to use 21 cm radio as the preferred medium of interstellar communication is highly questionable. Millimeter radio provides 40,000 times the data capacity for the same power and transmitter dish size, while offering a beam diameter of 9.5 AU at 10 light years—more than enough to make tracking the receiver planet unnecessary.

The higher-frequency, shorter-wavelength transmitter systems achieve their

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Table 2. Data Transmission Possible with 10 MW to 10 Light Years

Technology	Wavelength	Transmitter/Receiver	Data Rate	Beam diameter
L band	21 cm	70 m dish	1.4 b/s	1998 AU
X band	3.5 cm	70 m dish	50 b/s	333 AU
Millimeter radio	1 mm	70 m dish	61,000 b/s	9.5 AU
Laser Optical	0.5 micron	5 m telescope	6,378,000 b/s	0.066 AU

higher data rates because they can be focused with a much tighter beam. Some SETI researchers frown on them for this reason—unless they are pointed directly at us, we won't see them. But that is precisely the reason why they are probably preferred! Few people design their communication systems for the benefit of eavesdroppers.

The answer that the L-band SETI researchers have is that ET may be broadcasting in order to try to advertise their existence to potential correspondents. Well, maybe, but why do it with an inefficient, ephemeral communication technology? But I think it is more likely that they will want to choose their pen pals themselves. It would be irrational for any civilization to give away its position and other vital intelligence to a universe filled with potentially hostile competitors by broadcasting powerful radio signals indiscriminately in all directions. Indeed, the survival value of such a custom could be so negative that any civilization which adopts it may not last to do it very long. Even if the large majority of ET societies are benevolent and "civilized," it only takes one bunch of paranoid-aggressive emergent Type III savages armed with weapons of mass destruction to launch a pre-emptive strike of catastrophic proportions. Caution in opening communications may thus well be the rule.

Ground-based radio SETI research is a long shot, but it is cheap, and the potential payoff is enormous. It should therefore be continued, and in fact expanded to include higher frequencies right up though the optical. But if we want a real chance of finding ET, we may have to employ an alternative approach such as using radio and optical telescopes to look for the spectral signature of high-energy emissions from the propulsion systems employed by interstellar spacecraft. Propelling large starships across interstellar distances at relevant speeds requires a great deal of power, and each of the types of propulsion systems that might be employed—antimatter, fusion, magnetic sails, etc.—would release this power into the Universe in a characteristic way that could be readily distinguished from natural astrophysical phenomenon. Furthermore, unlike communication, which is governed by a fairly arbitrary selection of technology and mutually agreed-upon conventions, transportation systems are governed much more stringently by the laws of physics. No understanding of alien psychology is necessary to detect a starship. Thus, the best way to find ET may not be by trying to overhear his conversations or searching for his robotic scouts, but by listening for the sound of his engines. (For a detailed discussion of possible techniques, see the author's article, "How to Find a Starship," *Analog*, August, 1994.)

It's worth a try.

Galactic Civilization

While the assumption of a moderate (50,000 years or less) value for L readily explains the absence of extraterrestrials on Earth in the present, unless very low values for L and V are chosen, it is difficult to understand how it could have been inaccessible to outsiders at all times in the past. The solar system is moving with respect to other nearby stars with a relative velocity of about 10 km/s. So even in most cases where the

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Table 3.
Average Time between Earth/ET Domain Drift-Through Encounters (millions of years)

L(years)	V=0.005c	V=0.0025c	V=0.001c
5,000	15,645 Myr	62,582 Myr	391,139 Myr
10,000	1,955 Myr	7,822, Myr	48,892 Myr
20,000	244 Myr	977 Myr	6,111 Myr
30,000	71 Myr	289 Myr	1,810 Myr
40,000	29 Myr	121 Myr	763 Myr
50,000	14 Myr	62 Myr	390 Myr
60,000	6.8 Myr	35 Myr	226 Myr
70,000	3.1 Myr	21 Myr	142 Myr
80,000	0.8 Myr	14 Myr	95 Myr
90,000	0	9.0 Myr	66 Myr
100,000	0	5.9 Myr	48 Myr
120,000	0	2.3 Myr	27 Myr
140,000	0	0.2 Myr	17 Myr
160,000	0	0	11 Myr
180,000	0	0	7.0 Myr
200,000	0	0	4.6 Myr

galaxy is only partially settled, the Earth should have drifted through somebody's interstellar empire at some time in its history. How many times depends upon all the factors we have considered so far, but mostly upon L and V. Keeping all the other factors (f_g, f_b, f_m, and t_r) considered in equation 2 constant with the same values we assumed earlier, but varying L and V, we can calculate the average probable time between such drift-through encounters. (Such a calculation is done by computing the average path length between settled domains and dividing that distance by the solar system's relative interstellar drift speed of 10 km/s.) The results are shown in Table 3.

The Earth has been habitable for creatures like ourselves for about 600 million years, and readily terraformable by anybody with a good bioengineering capability for 3.6 billion years. If we take our previous "best guess" case of L=50,000 years, V=0.0025 c, the calculations given in Table 3 show that our solar system, while unlikely to be within or very near a settled region today, has probably drifted through settled domains of interstellar space about once every 62 million years. So under those assumptions, it would appear that the solar system has been inside someone else's sphere of influence about 10 times during the 600 million years that the Earth has been prime real estate. Lower assumptions for L and V lead to less frequent encounters, but all in all, it seems that the odds are high that someone has stopped by.

For some reason, they didn't stay.

One explanation could be that they were orange K-star people (i.e. members of the cosmic majority), and regarded the excessive ultraviolet environment of our yellow G-star world with disdain. But any Type III civilization worth its salt should have been able to handle that problem.

A more intriguing explanation is that they chose not to invade because they thought it would be wrong to interfere with the development of a promising biosphere, or more interesting and rewarding to wait to see what it might bring forth.

This may seem like a bizarre idea—

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cosmic environmentalism, or perhaps cosmic husbandry or stewardship. But Type III civilizations, wielding the huge amounts of energy necessary for interstellar travel, will necessarily have enormous destructive potential. No species can last long as a Type III civilization if it is not also wise. In most matters, the long view is the wise view.

True, as discussed in conjunction with the SETI search, there could be anomalies, occasional examples of aggressive Type III societies, sufficient to make others cautious. But it is not true that the "noninterference" hypothesis requires *every* civilization in the galaxy to be well-behaved to explain the apparent lack of extraterrestrial intrusion; just our immediate neighbors.

Intelligence, I would argue, can take innumerable distinct forms, each of which can offer unique insights into problems scientific, technological, artistic, ethical, philosophical, etc. The development of such a new type of intelligence thus potentially offers much more in the long run to neighboring civilizations than the benefits associated with gaining possession of one more piece of cosmic real estate. Furthermore, aside from potential long-range benefits and esthetic, moral, or scientific appeal, the maintenance of a noninterference policy towards developing biospheres by a Type III civilization may have short-term positive survival value. Remember, Type III civilizations are intrinsically capable of inflicting destruction on an astronomical scale. Therefore, should any new Type III civilization show itself to be aggressive, it would be a menace whose existence could not be tolerated. Its older starfaring neighbors might therefore combine to wipe it out.

It seems likely, as I have shown, that bacteria are everywhere. So the subsistence of bacteria on a near-sterile planet like Mars over billions of years without further development does not constitute a true biosphere. In my view, such planets should be terraformed to make them a real home for life. But a true biosphere, filled with multiplicities of complex plants and animals in the process of evolving towards higher forms is something entirely different. It is unique; it is precious; it holds unfathomable promise. No sane species would destroy one for the sake of a little extra living space. The same is even more true for the case of a world or a solar system sporting indigenous intelligent life.

Type III starfaring civilization will therefore be qualitatively different from Type II interplanetary and Type I planetary societies in this important respect—no one species will ever expand to mastery of the entire galactic theater. The distances involved are too great, the required time span for the activity too long, the number of indigenous civilizations too vast, and the numerical and tactical advantages naturally accruing to defenders of a solar system against an interstellar invasion force so manifest, that no campaign of galactic conquest could ever succeed. Galactic civilization will not be an empire spread from a single Type III, but a society of many Type III civilizations linked together.

So the question is, when we meet the galactic club, will we be fit to join it?

Meeting the Universe

In my view, to be successful in joining the club we will need to have attained a degree of both technological and ethical maturity that can only come with having reached Type III status ourselves. In fact, far from being beneficial, there is good reason to believe that encountering a Type III civilization will be psychologically devastating for humanity, if we have consigned ourselves to a Type I role. One only has to look at human history to see the results when more primitive cultures have come into contact with the West. Humans require dignity. We cannot survive with the thought that we are beings of a lesser order. Turning off the radiotelescopes to perform a kind cosmic withdrawal is not an op-

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tion, as it amounts to conceding inferiority in advance. The only solution is to grow up.

Since time immemorial, many humans have prided themselves upon the conceit that we are the Universe's sole vessels of sentient life. If we maintain a scientific outlook, that conceit is likely to be destroyed. We will not be able to base our pride and dignity on the childlike notion that there are no others. Instead, we will have to grasp a deeper and more mature idea: that we are worthwhile not because we are alone, but because we are unique and precious representatives of something far bigger than ourselves. Something to which we can contribute—*as equals*.

We must *make* ourselves fit to join the galactic club.

On the other hand, if there is no galactic club, if the galaxy is really a Hobbesian jungle war of all against all, then technological maturity of Type III level is required for survival. Species with little empathy can still be allies; witness the strategic maneuvers of terrestrial geopolitics. But to survive in such a universe, we would need to become "worthwhile as friends, undesirable as enemies."

Finally, even if there are no extraterrestrials, making ourselves worthy to meet them is still what we need to do for our own sakes.

Type III calls. ■

Dr. Robert Zubrin is President of the Mars Society (www.marssociety.org) and the author of two nonfiction books The Case for Mars, *and* Entering Space. *His debut novel,* First Landing, *was published by Ace Putnam in July 2001.*

IN TIMES TO COME

Our May issue will offer an exceptionally diverse and memorable collection of short fiction, some of it parts of ongoing series, some of it completely new and independent. Dave Creek has a new "Splendor" novelette, Bud Sparhawk a "Sam Boone" yarn that's unusually outrageous even by Sam's high standards, and Jerry Oltion his first "Astral Astronauts" story in quite a while. Stephen L. Burns presents a novelette as unclassifiable and strangely haunting as you've come to expect from him, while Mike Moscoe's powerful "The Job Interview" may make you want to apply yourself.

Dr. William Sims Bainbridge's fact article, "A Question of Immortality," looks at a question our writers and readers have been arguing about lately, examining not only the inevitable philosophical issues, but the very practical matter of what kind of "immortality" we can achieve *now*. And, come to think of, it pairs rather nicely with at least one of the stories—but I won't tell you which one!

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Our Man in Pluvia

Charles L. Harness

Illustration by Kelly Freas

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Sometimes everybody tries to do something about the weather. The hard part is getting them to agree on what to do!

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Chesley ("Chigger") Jones looked down U.S. Highway 380 and saw disaster. Disaster in the shape of a big beautiful cumulus cloud.

Ellis, the foreman of the movie crew, had called him from Pluvia, all a-dither. "Hey, Chigger, this cloud, the locals call it The Texas Monsoon. I thought you guys said it never rains here!"

Monsoon? Chigger shuddered and thought of India, where the monsoon season typically produces 125 inches of rain per month. News of the cloud must have traveled fast. A few minutes later the Mogul head office had called. Chigger recognized the gravelly voice. "We may have to cancel. We're covered, aren't we? If it rains?" Meaning, if the studio had to cancel filming because of rain, the insurance company would indemnify the studio for the cost of producing the movie, less a deductible. "Jones, this is 'Hopi Holiday.' We've got to have full sunshine. Rain would kill us. And we can't hang around. Tomorrow morning the crew has to be in Roswell for 'I Married an Alien.' We're talking a couple of million. Check it out."

Chigger had groaned. That kind of exposure didn't allow a negative answer. "I'm sure we're OK. Just let me double check, get back to you." The head office would understand this as "I haven't the foggiest idea, but I'll find out and I'll fix it."

So he had called up the policy on his dashboard monitor, checked the exclusions. And he had groaned again. The policy carried no coverage for earthquakes, tornadoes, meteor strikes, flood, hurricanes, hail, snow, fog, sleet . . . or rain.

He tried to think back. It had been weeks ago that he negotiated the insurance policy. Maybe months. The head office had warned him, "Keep it cheap. Don't pay for a lot of stuff that can't happen." He remembered about rain. He had checked with Dr. Nebel, the consulting forecaster, who declared, "It hasn't rained in Pluvia since records were started in 1895."

"But *Pluvia?* Isn't that Latin for rain?"

"Exactly. A fine example of the Texan's love of emphasis by stating the opposite. Like the Elysian Fields."

"Oh. Yeah." He recalled that the Elysian Fields was a forty-square-mile tract of pear cactus.

Dr. Philo Nebel was an honorary member of the famous World Meteorological Organization—the WMO—which possessed over two hundred signatory nations with 15,000 land weather observation stations, 10,000 stations in ships at sea, 65,000 moored and drifting buoys, a dozen weather satellites. Plus upper air data retrieved hourly from 2,000 weather balloon sites; continuous reports from commercial aircraft; with minute-by-minute reports sent to the U.S. Weather Bureau in the District of Columbia, indeed to all member nations. Surely with all this, thought Chigger, Dr. Nebel could tell him with certainty if it was going to rain in Pluvia, Texas, today, August 20.

A big sign at the road side: Pray for Moisture. Chigger groaned once more. A mile farther on was another sign: Pray Harder. Chigger sighed.

The four-lane highway stretched out ahead, flat, endless and, save for the towering cumulus disaster, empty. Likewise behind him.

He thought of General Sherman's opinion of Texas, based on several months army service before the Civil War. "If I owned both Hell and Texas, I'd live in Hell and rent out Texas." And old Cump had been stationed in the nice part of the Lone Star State. He shrugged, checked the air conditioner thermometer. Eighty-seven. Fortunately with low humidity.

He was approaching the turn-off to the temporary movie lot and he could see the line of trucks and trailers. All that would be gone tonight and on its way to the production of another cheapie several hundred miles away. He wondered if he should stop, check in with

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Ellis, then decided maybe later.

As he entered Pluvia, he could look down Main Street and see all of the cloud, from top to bottom, side to side. Just sitting there, visibly throbbing. Waiting to let loose.

He focussed the camera on the monster and called Dr. Nebel on the web. "Well, there it is. *Now* what do you think?"

He listened to the thin metallic voice of the meteorologist. "Well, bless us! The rare and famous Texas Monsoon! Standing there like a beautiful woman. She requires no makeup, no designer wardrobe. Her grace, her charm carry her without need for more. I—"

"Doc, is it going to rain?" Chigger spoke between clenched teeth.

"Rain? Hm. Let's see. About six-tenths mile on a side, wouldn't you say? Same for the height? Call it a cubic kilometer. Which contains about 4 million kilos of water—a bit more than a million gallons. Hm. Yes, I can see your concern. The Monsoon. Hm. Shows up intermittently this time of year."

"Doc, is it going to rain?" It came out as a harsh wail.

"Rain. Well. Perhaps I'd better explain. Most of that water is tied up as tiny crystals of ice. And yes, they fall, and they melt, and they become raindrops, and *they* fall. But as they fall they evaporate. They become virga—they're gone long before they hit the ground. So, rain? Yes, lots of rain. But rain on the ground, no, not a drop."

"So 'monsoon'—just bitter Texas irony again?"

"Exactly. However, while we're on the subject, I might alert you to another fact that has just come to my attention. An attempt will be made sometime today to seed the cloud by air. It will fail to produce rain."

Off again, on again. . . . "How can you be so sure?"

"History, Mr. Jones. In the last fifty years, commercial seeders have made several assaults on the Monsoon, using dry ice, silver iodide, sodium chloride, water sprays, plus various other mixtures. Not a drop of rain. Check it out, if you like. According to the map, the Pluvia airport is just east of town."

Maybe a low priority on that one, thought Jones.

Dr. Nebel added, "I presume the studio is aware of the risk inherent in the movie script."

"Huh?"

"The ceremony . . . the snake dance."

Chigger had to think a moment. "Oh, you mean, the rain dance? It could actually produce rain?" He thought a moment. "You're serious?"

A silence.

The expediter continued. "A snake dance? Nah." Nebel was teasing him. "Nobody can make it rain holding snakes and prancing around half naked. Too weird . . . Hold on . . . emergency flash from the head office. Catch you later. Yo. Jones here."

That gravelly voice again. "Jones? Somebody has just filed a petition for a restraining order against making the film. They claim copyright infringement plus some other stuff . . . desecration of tribal religion, unfair trade practice, threat of devastating crop loss and so on and so on. Meet with their lawyer right away. Here's the address. . . ."

"I—" But the screen blanked. Chigger immediately cross-checked the address in the local directory. The Hopi Nation? Headquarters in Arizona, but with a legal deputy here in Pluvia. He brought up the directory of officers. Here we are, thought Chigger. Local counsel: Warren Blackwolf. He punched more keys. An advertising video popped up on the monitor, a tall man striding along, dark skin, broad cheekbones, black eyes. Walking up the courthouse steps. A flowing animal grace. In the courthouse corridor, talking to reporters, smiling, eyes lively. Laughing. Perfect teeth. Rich modulated voice. Ph.D., Tri-State Bar. Still under forty.

Chief, thought Chigger, you've come

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a long way from the reservation. We'll see.

Meanwhile, let's just double check the fine print in our insurance policy. He pulled up the 'Hopi Holiday' contract. "Voice," he said, "Section three."

Words came back instantly. "Unless listed in the Exclusions, any thing, event, force, or cause whatsoever (herein collectively, Cause), which despite Insured's best efforts, prevents filming the Movie on the Date or Dates, including without limitation of the generality of the foregoing: Force majeure, strikes, death or disablement of star personnel—"

"Stop. Jump to Exclusions."

"Litigation initiated by third parties—"

"Stop." Ouch. The Hopi suit was not covered. We're in trouble. Back to square one.

Pay attention now, thought Chigger, we're coming into Pluvia, Rodleigh County Seat. Speed limit thirty mph. He slowed down to fifty, found the Civic Center, parked.

Dr. Blackwolf greeted him pleasantly and waved him to a chair. Chigger stood for a moment, looking at the pictures on the wall—mostly just Indians going about their daily tasks—and one painting in particular. It was a big one, showing men dancing in a circle, each with a snake in his mouth. Chigger thought he had seen something like it before in a Baltimore art gallery. "Kabotie?" he asked.

Dr. Blackwolf smiled. "Yes. Fred Kabotie's famous *Hopi Rain Dance*. Not the original, of course, but a fine copy. You're familiar with the ceremony?"

"Some of it, I guess. Anyway, Doctor, that's what I'm here about. I represent Mogul. You've applied for a restraining order to stop the film. The studio stands to lose a great deal of money."

"Yes, I know."

"I think maybe the problem is you just don't understand what Mogul wants to do."

"So tell me."

"Well, according to the script, they'll have these dancers do the dance, proper costumes, makeup, snakes, the whole schmear. Takes about an hour, maybe a little longer if they need retakes. At the end, there'll be spray from a hose, about five minutes. No real rain. We promise we're not really going to make it rain."

Dr. Blackwolf smiled. "We never thought you would. That wasn't our concern. Not at all."

"So what's the problem?"

His host hesitated. "Mr. Jones, I fear this is going to be difficult for you to grasp. Our concern stems from our religious beliefs. Our people think your Hollywood rain dance would be a hideous mockery of the real thing."

"But . . . we . . ." Chigger stared blankly at the tall man.

"For starters," Blackwolf said, "the ceremony must be done in late August in Hopi tribal lands in northeastern Arizona. It cannot be done at other places, other times. There is a ritual that must be followed exactly." He gave the visitor a questioning look. "For example, when it's over, what are you going to do with the snakes?"

Chigger shrugged. "Return them to the zoo, I guess."

"You see? That would never do. The priests consider the snakes to be their brothers. They have to be returned into the desert and released, so that they can carry the prayers to the goddess."

". . . goddess?" Chigger stared at the tall man. "But that's . . . witchcraft? Surely you don't believe in that stuff?"

"Actually, I don't. On the other hand, a great majority of my fellow tribesmen do believe, including several influential voices on the Hopi council."

"Well, OK, how about if we turn the snakes loose in the desert?"

"Mr. Jones, I'm afraid you don't get the point. A proper ceremony takes nine days. The dance itself is merely the concluding climax." He paused, took a deep

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breath. "Let me explain. You'll pardon me if I go into some detail."

"Sure, go ahead."

"Well, first, the kiva—the ceremonial cavern—is cleaned and made ready. Access is by a ladder through a hole in the roof. The dancers are selected. Until the end, they must abstain from sex, salt, and meat. Figures are drawn with colored sand on the flat rock floor of the kiva and a bowl of pure spring water is placed on an altar in the center. Men go forth into the desert and catch the snakes, which are then brought down into the kiva. Participants sleep in the kiva with the snakes for four days, praying, singing, meditating. On the final morning, they light the fires in the crypt, the smoke rises into the sky and beckons to the rain clouds. The men purify themselves by sprinkling ashes on their bodies with their left hands."

He studied Jones quizzically. His visitor nodded silently and Blackwolf continued.

"The snake dance begins. When it's over, the snakes are set free in the desert or in other sacred places, and the dancers take an emetic. Everything is removed from the kiva, and the sand pictures are erased. The rest is up to the rain goddess."

He faced the visitor with deepset melancholy eyes. "You see, we Hopi have been celebrating the marvels of nature for many centuries, long before you Pa-ha-na came to the desert with your strange ways."

"Yes." Chigger was thoughtful. "But let's try something. To register your copyright, you filed movies with the Library of Congress?"

"Of course."

"Let us check your movies. If they have what we need, perhaps we can use your rain dance. We drop our dance, and you drop your suit."

Dr. Blackwolf thought about that. "Actually, you already have a copy. We filed it with the complaint. Your people have probably already checked it out."

"Well then, let's see what they think. Use your phone?" He placed a phone call, switched to speaker. "Ellis, I'm sitting here with the Hopi lawyer, Blackwolf. You've seen their film? OK. They offer a buy-out. We don't film the dance. They're absolutely firm on that. It violates their religion. Instead, use their film. Pay them fifty thou. They drop the petition." The voice came in, scratchy, hesitant. "Yeah, but fifty G's . . ."

"Don't screw me up, Ellis. I've negotiated this down from a quarter million. Look, our dance is budgeted at a hundred thousand. You'll not only be saving fifty thousand, you'll be bringing in the product two hours under schedule. You'll be out of here by three-thirty this afternoon. Four at the latest."

"Well, OK, but only as a personal favor—"

"And one more thing. Lawyer Blackwolf wants the Hopi Nation listed in the credits, plus the names of the individual dancers."

"Yeah, we can do that."

Chigger clicked off.

Dr. Blackwolf looked at him with arched eyebrows. "Fifty thousand dollars?"

"Makes it look genuine. For free, they'd be very suspicious."

"I owe you one."

Chigger rose to go. "No problem."

His host remained seated. "You don't want it to rain. There's that cloud . . ."

Chigger was instantly alert. "The Texas Monsoon?" He sat back down. "But we have been assured it won't produce any rain."

"And you could be right. On the other hand, I understand an attempt will be made to seed the cloud this afternoon."

"We know about that. Our meteorologist assures us it won't work."

"Is he aware they'll be using a new seeding agent?"

"I . . . well . . . I don't know. I guess not. He mentioned dry ice, silver iodide . . . ?"

"Let's back up, take a look at the mechanics of making a raindrop. The cloud

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top has to be below freezing. The cloud droplets freeze, make ice crystals. The crystals fall, melt, become raindrops. But in clouds like the Monsoon, it's a long way down and they evaporate before they reach the ground. OK?"

"Yeah, I guess so." Chigger sounded dubious.

Dr. Blackwolf smiled. "So why does the Hopi process work? It works because it provides a very special nucleating agent: smoke rising from the kiva catches an updraft and enters the cloud and seeds it. The smoke consists of microscopic particles that are very efficient at attracting water molecules and forming raindrops and inhibiting their evaporation. Those new seeds that will be tested today are synthetic organic molecules that just happen to be very similar to our Hopi smoke particles. We think they may prove quite effective."

Chigger stifled a groan.

Blackwolf continued. "Actually, their attempt might be very interesting. It's not generally known, but there is in fact a statute on the books from back in 1905 or 6, where the county offers a reward for successful rainmaking. Never claimed . . . long forgotten."

So why bring it up? thought Chigger. Let it lie!

"We doubt that the seeders—the Carter brothers—are aware of the statute—or," observed Dr. Blackwolf, "that the new seeds are patented."

Chigger sat up straight. "Patented? You wouldn't happen to have the patent number?"

The lawyer reached into a desk drawer and pulled out a document. Chigger glanced at it briefly. "Borrow this?" Without waiting for an answer, he grabbed the patent and ran from the room.

By the time he strapped on his seatbelt, he had read the name and address of the inventor on page one of the patent and had placed the call. Guthrie W. Keyman, Newton, Kansas. On the way to the airport he connected. Yes, the patented composition (Keyman called it 'nimbo') had worked as an insecticide in Kansas cornfields. Cloud seeding? No, never heard of it. No, he hadn't licensed his patent to anybody for cloud seeding. Yes, he'd be happy to license . . . sure, Mr. Jones, you can handle it. Just keep me advised.

As he drove back into town, Chigger composed a licensing contract. Nimbo Seed Company, Licensor; Carter Brothers, Licensee.

He drove slowly around the parked planes at the little airport and soon spotted a twin-engine Piper Chieftain, the only plane with cartridges installed on the wings. A youth seated in a nearby lawn chair laid aside a comic book and looked up as Chigger drove up.

"Cloud seeder?" Chigger asked.

"Yo."

"You run the show?"

"Naw. That's my brother Willis."

"He around?"

"Naw. He's in court today."

"Oh? Who's he suing?"

"Nobody. We're getting sued. Some dude in Alameda County is all shook up about the Monsoon. Claims we can't seed it. There's a hearing going on right now."

"In the courthouse?"

"Yeah."

"OK. I'll catch him there."

And so back into town, into the courthouse parking lot, and up the stairs. He scurried down the main corridor, peeking into every courtroom (mostly empty) until he found the right one.

Panting, he took a seat close to the bar. He was the sole spectator, but nobody paid any attention to him. A weatherbeaten man of middle age sat at plaintiff's table with his lawyer, a short corpulent man in a light three-piece seersucker suit. At defendant's table sat a young man in a simple white T-shirt and blue jeans, and next to him another youth, likewise clad in three-piece seersucker. Courtroom dress code? thought

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Chigger. Despite air-conditioning, the suits of both lawyers showed damp spots at the armpits. The judge was fanning himself slowly with a cardboard fan. He looked bored. Chigger wondered if he was wearing anything underneath his robe.

Plaintiff's lawyer rose. "In closing, your honor, let me emphasize, my client, The Cotton Growers Association of Alameda County, does not claim ownership of that cloud known as the Texas Monsoon. But we do claim certain rights with respect to the cloud, including the right not to endanger our crops with the artificially induced fall of hail. Defendant proposes to try out a new seeding technique. He proposes to use our fields as his guinea pig. He claims seeding would produce only rain. We think it would also produce hail. Rain we do not need. Our fields are irrigated with water drawn from an underground aquifer. We are content with the status quo. Indeed, we *insist* on our status quo. Let respondent test his new seed on some other cloud. The temporary injunction should be made permanent." He sat down.

Defendant's lawyer arose, cleared his throat. "Your honor, my client isn't trying to disturb the cotton fields of Alameda County. He's just trying to test a new seeding technique that may prove of great value to agriculture in the Plains States, and to this county in particular. True, we presently irrigate. From our aquifer, we take 70,000 acre-feet per year. This is partially replenished by 45,000 acre-feet from rainfall outside our area. This leaves a shortfall of 25,000 acre-feet. In twenty-five years our aquifer will run dry. We need to start making up the shortfall now. We need people like my client, people who are ready to try new things. We need to get a plane up into the Monsoon with the new seed. We need to end the current water shortage. The injunction should be terminated." He sat down.

For a moment, the judge just sat there and seemed to study his notes thoughtfully. Then he laid down his fan, picked up his water carafe, made as though to pour a glass of water, shook it, then replaced it. He mopped his brow and arose. "I'll be back in a minute." He didn't head for the door that led to his chambers: he walked out the front door of the courtroom. After a moment's hesitation, Chigger got up and followed unobtrusively.

The judge walked to the west end of the corridor and looked out the window.

The cloud, thought Chigger. He's studying the cloud. Whatever for? And here he comes.

The agent ducked into a stairwell as his honor strode past, then hurried after him. The two resumed their seats simultaneously.

The judge spoke in measured tones. "I find as follows. The Monsoon is presently approaching the border between Alameda and Rodleigh Counties. It is moving east at the rate of about one mile an hour. In one hour, it will be entirely within Rodleigh County. Seeding can have no impact on the Cotton Growers of Alameda County. The matter is therefore moot. The injunction is terminated, the case is dismissed."

Jubilation at defendant's table, dark scowls at plaintiffs.

Chigger sighed. Time to act. Sometimes he hated his job. He passed the bar gate and approached the young man at defendant's table. "Mr. Carter?"

His quarry looked up in surprise. "Yeah?"

"I represent Nimbo Cloud Seed Company. It has come to our attention that you propose to seed a local cloud with our patented product."

"Huh? *Patented?*"

"I have been to the airport, Mr. Carter. I have seen the installations on your plane."

"Yeah. Well, look, Mr.—"

"Jones."

"Mr. Jones. If you'll excuse me, I've got to get out there, get up in the air

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right away."

"I must warn you, Mr. Carter, you will be infringing our patent."

Willis Carter hesitated. "But they were selling it as an insecticide. We'd be using it for cloud seeding—a brand-new use. We discovered our seed clings tightly to water molecules, inhibits evaporation of rain drops. No more virga. The raindrops fall to the ground. The mechanism is completely different from use as an insecticide."

"Sir, it makes no difference. We claim it as a new composition of matter. Any manufacture, use or sale without a license is an infringement, regardless of whether it's a new use or not." Chigger paused, then added evenly, "And since the infringement is deliberate, you will be liable for triple damages."

Willis Carter stopped, turned back, looked at his lawyer. "Can he do that?"

The attorney's shrug was eloquent.

"It's coming up on one o'clock," Chigger observed. "The cloud seems to be stuck in place. Why don't we have lunch at the corner diner? Talk business."

"Chili's really pretty good," Chigger observed, finally pushing his bowl away. "But I could use a glass of water."

"Have to ask for it," Willis Carter said. "Water shortage. They're real strict about it."

"Oh . . . ? Let it go."

Carter's lawyer looked at his watch. "You wanted to talk business, Mr. Jones?"

"Yes, glad you reminded me. How much money were you going to make on this test run?"

Willis Carter shrugged. "None. It's just an experiment. If it works, we look for clients."

"Ah. Hm. You're familiar with County Resolution twenty-seven of 1905?" He looked at blank faces.

The young seeder said, "Uh, no, can't say that I am."

"That's the Rainmaker Resolution. You don't recall . . . ?"

The lawyer said, "Something vague . . . no . . . just can't seem to . . ."

Chigger pulled out his palm reader. "Here, take just a second to bring it up." He punched keys. "There—Resolution twenty-seven, May 10, 1905. See there? The county offers a reward for making rain. One-tenth inch in twenty-four hours gets you ten thousand dollars. A lot of money in those days. Do you think you might qualify?"

Willis Carter stared wide-eyed at the reader. "I'd like to try."

"You would need a license under our patent. Now, just thinking out loud . . . our introductory offer . . . which I'll have to check with our home office . . . our cut is normally fifteen percent of your actual receipts, but since you're just starting out, we'd be inclined to take only ten percent, with right of audit. We give you an exclusive license under the patent for the tri-state area. You could seed for any purpose . . . hail control, rain, tornado control, fog on the runway, whatever. What do you think?" He stole a look at his watch. He would need to stall this to give the movie crew time to finish up.

"What if we say no?"

Chigger sighed. "Triple damages, Mr. Carter. Plus a permanent injunction. And whether the seed works or not, we attach your plane." He checked his watch. Two-thirty. Thirty minutes for Willis to get back to the airport and get the plane into the cloud. Three o'clock. Too soon. He needed more time. "Discuss it with your lawyer while I call it in to the head office. I'll be in my car."

Fifteen minutes later the two emerged from the diner. Willis was ready to sign. "We have to wait a few minutes," Chigger explained. "The head office is in an uproar about that ten percent. Can't see why it can't be the usual fifteen. They're taking a vote, and we'll have a decision by 3:30 local time."

They looked up at The Cloud. It was still there, buxom, seductive.

Chigger said, "Depending on results

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here, you chaps might want to consider participating in our operation in Libya."

"Libya . . . ?" said the lawyer.

"Yeah, big deal in North Africa . . . rain on the Sahara. Looking into the possibilities."

Willis Carter said, "We'd need a cloud." He began to describe in detail a possible North African operation and when that was done he launched into plans for the Gobi Desert in Asia.

Chigger hated to interrupt. He checked his watch. "Hey, it's after 3:30, and no word. Our deal stands. Here's my pen. Copy for you. Off you go, and good luck."

"Chigger!"

The expediter recognized the voice of the crew chief. He sensed despair.

"Yo. "

"We're stuck here. We needed that one last spray from the hose, you know, to show the dance actually brought rain. But the sheriff came—turned us off. Something about water conservation. Can you fix it? Maybe get an emergency court order?"

Chigger looked at his watch. Four o'clock. By now Willis Carter should be weaving in and out of the Monsoon, scattering that mysterious new seed. And would it really work? Nebel had said nothing would work. Still— He said, "Let me look into it."

A framed legend hung on a wall in Philo Nebel's office in Alexandria, Virginia. Dr. Nebel had recovered it from the dwelling of an astrologer who had died in Pompeii 79 A.D. as a consequence of the eruption of Mt. Vesuvius. He had judged the legend to be appropriate for a practicing meteorologist.

Adjacent to the Latin inscription was hung a big flag with a red square in the center. This was one of the flags flown from county courthouse flagpoles in the closing days of the nineteenth century, when weather forecasting was handled by the U.S. Signal Corps. The flag was hoisted when a local blizzard was imminent.

On his computer desk sat a radiosonde—a quite primitive affair. Indeed, the very first, sent aloft with the first weather balloon nearly a hundred years ago.

But his prize was displayed on his desk in a locked glass case: the key that Benjamin Franklin claimed he had used in flying kites into Philadelphia thunderstorms. Actually, Dr. Nebel secretly doubted the claim. For if Franklin had truly touched the key in a storm, he would have been struck dead.

And now he was on the phone again with that pesky Jones. "No, Jones, I repeat—nobody can pull rain out of a Texas Monsoon. I have been watching this carefully ever since you called my attention to it. My computers have made billions of calculations. Billions, Mr. Jones. I have even applied chaos math. Both of our local weather satellites report no rain and no chance of rain. We have reports of temperature and humidity at nineteen levels of atmosphere, with standard photos and infrared. We have examined the size and shape of ice crystals in the cloud. We have estimated the impact of La Niña and found it to be negligible. Miraculous new seed? Nonsense! For a seed to really work, it would have to duplicate Hopi smoke, and that's impossible. Sure, it'll probably make a little rain, but it'll all evaporate on the way down. No rain on the ground, Mr. Jones. None. I absolutely 100 percent guarantee. I am never wrong. Never!"

Chigger was very thoughtful as he signed off.

It had definitely turned cool. The AC thermometer read eighty-two. He turned it off and rolled down the car window. His right knee had begun to ache. That old football injury. He knew what caused it. Atmospheric pressure was dropping and the reduced pressure was releasing tiny bubbles of gas in his

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knee joint. He looked up, caught his reflection in the rear view mirror. His hair looked curlier. Sure sign of increased humidity.

The cloud now obscured the afternoon sun and it was growing dark. He stuck his head out of the car window and listened intently. Far overhead he thought he could hear the Piper Cheftain.

Off to one side of the road stood a cottonwood tree. Its leaves were beginning to invert. He watched with interest as a flock of birds flew low over the field, where grasshoppers were making a great racket. He turned around, looked at the box of papers tied up on the back seat. The strings had tightened.

He called Ellis. "I think I can give you a nice local shower. Get your cameras out."

* * *

Dr. Nebel watched the numbers as they came in from the Pluvia grid point. At first he didn't believe them. The dew point had risen to saturation. Pressure had dropped three mb in the last hour and was still falling. Rain. Heavy, falling to the ground. It couldn't be precisely measured, because there were no rain gauges in that part of the county, which had never before seen rain. But there it was, confirmed by Doppler radar. That demon Monsoon. How could it do this to him? And the rain kept coming. He suppressed a shudder. Oh, he would hear about this!

As he turned off the light, he looked back at the Latin legend, the curse of the meteorologist: "VERUS MEMINISSAT NEMO: FALSUS OBLIVISCAT NEMO. When you are right, nobody remembers. When you are wrong, nobody forgets." ■

Imagination is a quality given to a man to compensate him for what he is not, and a sense of humor was provided to console him for what he is.

—Oscar Wilde

Knowledge once gained casts a . . . light beyond its own immediate boundaries.

—John Tyndall

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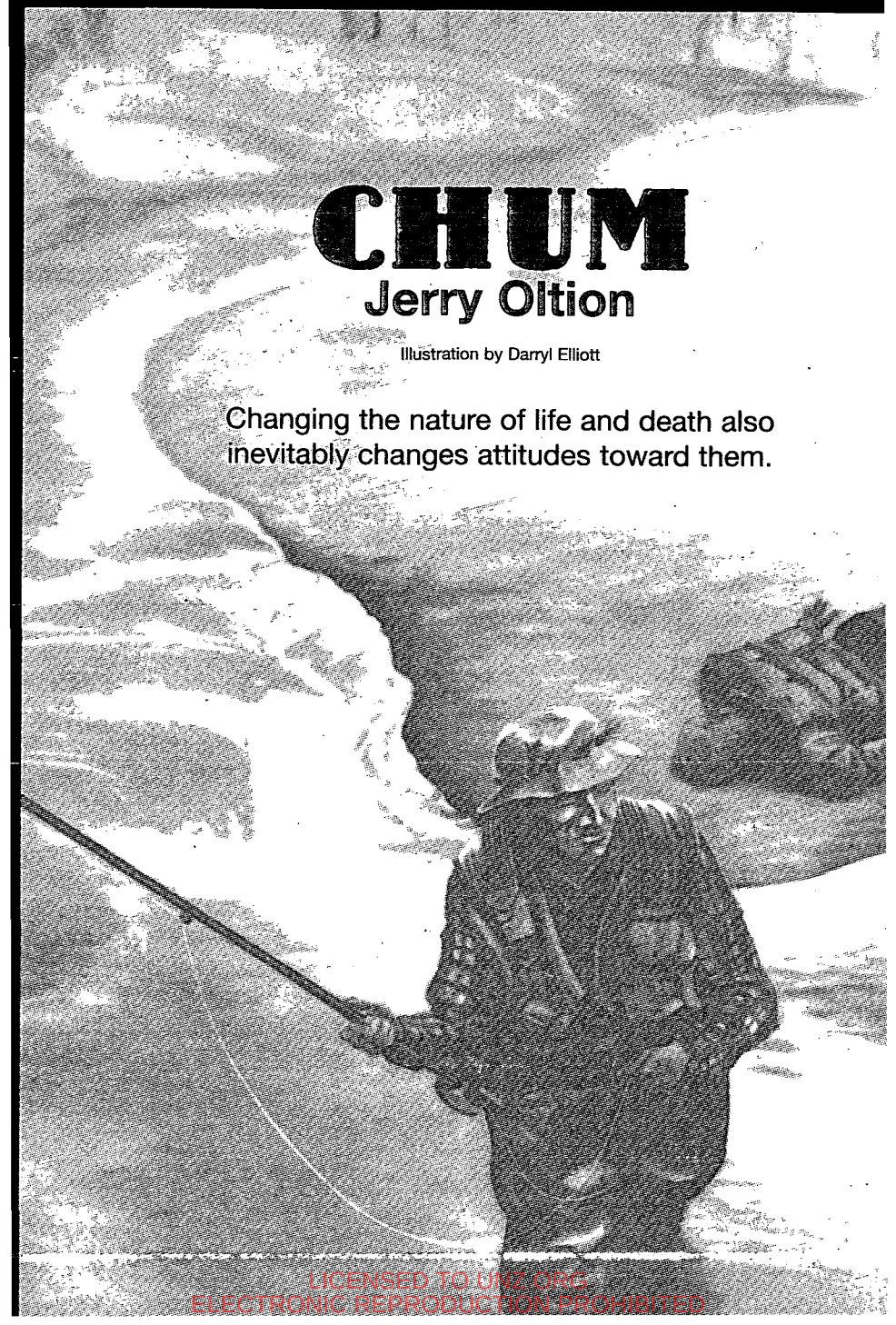
CHUM

Jerry Oltion

Illustration by Darryl Elliott

Changing the nature of life and death also inevitably changes attitudes toward them.



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The third time Todd scraped the aircar over the top of a granite boulder, Doug could no longer hold his tongue.

"You want to give 'er a little more lift, there, dude?" He tried to keep it casual, but Todd heard the irritation in his voice. He could feel it over his neural link, too. Doug was masking it as best he could, but you didn't know somebody for fifty years without picking up on their thoughts.

"Hey, chill," Todd said, easing the car up a notch. "It's my car. I'm just scrapin' the rust off."

"Scraping the lifters off, more likely," Doug muttered. "You wreck those and we're in for a long walk home."

That much was true. They were in the Bighorn National Forest, somewhere between Battle Park and Lily Lake. The last sign of civilization had been a laser-shredded beer can five or six kilometers back, and the last sign of a trail even farther. But Todd was pretty sure he knew where they were, at least within a kilometer or two. He'd been here once when he was a boy, nearly three-quarters of a century ago, back when the road was still a road and the forest was a bunch of stumps. It looked a lot different now, but he remembered the terrain. He also knew what his car could handle. He'd low-glided over a lot worse than this and brought it home in one piece.

"If we wreck the car, it'd be closer to walk to the lake than back home," he said, grinning when he saw Doug stiffen. Doug wasn't a whole lot younger than Todd, and while he exercised all the time in a gym, the idea of actually using his muscles for real work hadn't crossed his mind for decades.

"Just kidding," Todd said.

Doug ragged on it anyway. "Oh, yeah, that'd be smart. Then we'd have to walk out from *there*. There's no taxi service in the wilderness area."

"No, but there's fish. Big mothers, with huge, gaping mouths!" Todd squeezed the car between a couple of lodgepole pines, tilting it a little to starboard so it would fit. All the loose gear in the back seat slid over to that side, and Doug turned around to make sure it was OK. Not that it should have mattered to him; his stuff was bundled tight and tied down in the trunk. Sort of like the Doug Todd used to know.

"Lighten up, man," Todd told him. "We're supposed to be having fun."

"Is that what we're doing." Doug somehow managed to turn the question into a statement of fact and a condemnation of everything Todd stood for at the same time. Todd wondered—not for the first time—why he'd chosen him for a companion on Todd's first fishing trip in nearly a decade. Doug didn't even like fishing all that much.

That was probably it. Doug hadn't won a license. He hadn't even put his name in the lottery. Todd had figured he would be the least likely of all his friends to be jealous when they got there and he had to stand back and watch.

Plus he was a total digit-head. He had a brand new, state-of-the-art Thinkman cranial implant with full sensory sweep and compartmentalized storage. When Todd latched onto a monster rainbow, Doug could tap into Todd's neural link and record the whole experience *from Todd's point of view*, preserving the moment with perfect fidelity, untainted by his own lack of enthusiasm for it.

Provided they ever got there. The map showed a road all the way to Lily Lake, but by the looks of the vegetation, nobody had come this way since the days of four-wheelers. The greenies loved the way the forest was coming back, and Todd had nothing against trees, but was it too much to ask for a path wide enough to squeeze a car through?

He reached out as they glided past a low-hanging branch and let the needles brush across his palm. A puff of yellow pollen billowed up from the tiny male cones at the end of the branch. It

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smelled a little like yogurt, the plain vanilla kind with maybe a little oregano sprinkled in. The whole mountain smelled like oregano to Todd; oregano and rosemary and basil. It was a discovery that kept him sane between trips. When he needed a mountain fix, he would open a bottle of Italian seasoning and take a big nose hit. It was a pale imitation of the real thing, but that and a memory playback was better than nothing.

He sneezed. The car jerked to the left, the skidplate clanging off another rock. Doug tensed up, and Todd increased the lift another notch, but he watched the power gauge quiver on the redline as he did. His car really wasn't designed for off-roading. The repulsors were only good for half a meter, and they sucked power like a short circuit at that.

"It'll be easier going up ahead," he said, pointing beyond the windshield to where patches of light brown grass peeked between the tree trunks. "That's the bald ridge. Smooth as silk from there."

Doug leaned forward and looked up at the sky, which had been growing grayer over the last hour. "Good timing. Looks like a thunderstorm coming."

"There's always thunderstorms up here in the summer. We'll be fine."

The last fifty meters or so of forest were clogged with bushes. It was always that way, because more sunlight could make it through the canopy there, but it still felt like some vegetable conspiracy to keep them from getting through. Todd nosed the old flyer into thicket after thicket, trying to find one that would let him through, but he finally had enough of it. He backed off a couple of car lengths from the last one he'd tried and said, "Hang on to your hat; we're going through!"

"Wait a minute," Doug said automatically, but Todd tromped the juice pedal and the car shot forward. Branches slapped at the windshield and snatched at their arms through the open windows, and the smell of crushed leaves and splintered sticks rose all around them. There was a jouncy moment of total green-out, then they blasted through to the other side, bobbing like a cork in rapids until Todd brought the car under control again and coasted out into the open meadow.

Yellow grass stretched away up the slope ahead of them and off to the left, where little patches of forest were slowly reclaiming an old clear-cut. To the right, the ridge fell away into a wide, U-shaped glacial valley. They could see a chain of lakes down there, and a glistening silver stream meandering between them.

"Whoa," Doug said. "Nice." He stared down at it, panning left and right, then turned his attention to the snow-capped peaks at the head of the valley. Recording the sight. Good. Maybe now he'd start getting into the trip a little. Todd considered asking him to record *his* impression of it, too, but he decided not to push it. Besides, he'd actually rather keep it to himself. It wouldn't be quite as pure in natural storage, but it would be his very own. And somehow, not having it available for digital recall would make him treasure the memory all the more.

Besides, there were already more sensos of that canyon available on the net than a guy could download in a lifetime. It was one of the most popular spots in the Bighorns. "It's pretty," Todd admitted, "but there's probably not fifty fish in the whole drainage. They let twenty people a day up there, summer and winter. Place is practically a park. We're going to Lily Lake, on the other side of *that*." He pointed up and to the left, where the road zigzagged over the top of the bald ridge.

"Huh," Doug grunted.

Todd concentrated on driving. The road was easy to find out here; the weathered remains of wayposts stood in the ground every hundred meters or so, but the old four-wheeler ruts were just

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as easy to spot. Erosion had worn gullies that might never smooth over, even now that grass had grown over them again.

The sky to the west was slate gray. Wet slate at that, and the underside of the clouds roiled like a sheet in the wind. Todd loved mountain thunderstorms, but Doug had been right: this one was going to come uncomfortably close. That was cool, though. Part of the excitement. Like mosquitoes and bears; you took what the mountains threw at you, or you stayed home.

The ozone in the air bit at his nostrils. No oregano now! This was more like fresh-filed metal, sharp and crisp and hot. Sudden gusts of wind blew in through the windows, and Todd found himself struggling to keep the car from being blown toward the canyon. He lowered the lift and that helped a little, but it was getting a little hairy.

"I think I'm going to cross-country it down into that swale there," he said, nodding out to the left where a little fold in the mountainside sheltered a stand of stubby trees. Hiding under a tree during a lightning storm might not be the safest thing to do, but it sure beat hanging out on the ridgeline.

"Good idea," Doug said.

Todd turned the wheel and tilted it left a little for a smooth bank, and the car had just begun to swerve when a flash of light lit up the interior like a pack of paparazzi at a celebrity wedding, and their teeth rattled to a boom like God's teenage son slamming his bedroom door after a bad date.

"Whoo!" Todd yelled. "Close one!'

"Get us the hell out of here!" Doug yelled back.

"I'm trying!" Todd floored it, and the car surged ahead, but they only made it a couple of dozen meters before the world lit up even brighter than before and the thunder smashed them to the ground. The car skidded, slewed sideways, and caught an edge on a rock, tipping up far enough for the side air bags to blow. It teetered there for a second, then slammed back down on its skidplate, raising a cloud of dust both inside and out.

"Holy shit," Todd said over the ringing in his ears. "I think that one hit us!" The car reeked of ozone and smoke.

"Duh!" Doug shouted. "Get this hog back in the air! Now!"

"Yeah, good idea." Todd hit the lift button, but nothing happened. He punched it off, then back on again, but still nothing.

"Must've blown a breaker," he said, reaching for the panel under the dash, but the moment he touched it, he yanked his hand back in pain. "Yow! It's hot!"

Doug leaned over into the back seat and grabbed one of Todd's loose shirts off the floor, then bent forward to try the access panel again, but when he yanked it open, smoke poured out and hot drops of molten metal spattered to the floor.

"Yow!" Todd squirmed away before they could burn his feet, but a moment later it didn't matter. The sky opened up and hosed a deluge through the windows, flooding the car so fast that the floor mat hardly even got singed.

"Well, at least the lightning's moved on," Todd said a few minutes later. They could hear it snapping and growling over the canyon now, probably scaring the bejeezus out of today's score of wilderness tourists.

He and Doug had scrunched into the center of the car to escape the rain. It was way too close for comfort for a couple of guys who didn't swing that way, but the windows wouldn't roll up and the back seat held as much of Todd's gear as they could sweep into the middle. It was looking like a dry sleeping bag and dry food might be more important than personal space, because the windows weren't the worst of the car's problems. The lifters wouldn't lift, the lights wouldn't come on, and not even the gauges worked anymore. The power

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pack was fried.

That meant the weblink was toast, too. The only functioning electronic devices left to them were the neural links in their heads, and those had about fifty meters of range at best. That was plenty to maintain a web connection in practically any civilized part of the planet, but the whole point of a wilderness area was to get away from that sort of thing. The car's uplink would have connected them if they'd needed it, but now it was as dead as the rest of the car.

"You didn't pack a spare link, did you?" Doug asked.

"Nope. Did you?"

Doug shook his head. "So what now?"

"Well, Lily Lake is only a couple more klicks," Todd said.

"You're totally hacked. If we walk anywhere, it's *out*."

Doug reached down and felt the rectangular bulge of his wallet in his left hip pocket. His fishing license was in there. *It* hadn't blown in the lightning strike, 'cause there was nothing but plastic to blow. It was coded and forge-proofed twelve ways from Tuesday, but it was just an inert certificate —one granting him the right to catch any fish in the Tensleep Creek drainage that would take a hook during the fourteen hours of daylight between dawn and dusk tomorrow. It had been eight years—eight years of running sims and backseating other people's sensos—since he'd had one of those in his wallet, and he'd be damned if he'd let a little lightning keep him from using it.

"Maybe you could walk out and call . . . no, forget it." Doug would just as likely get lost or get himself eaten by a bear if he tried getting out of here by himself.

"We'll have to start a signal fire," Doug said.

"In this rain?"

"When it's over, idiot."

"Hah. Good luck."

Doug grunted and leaned away for a few seconds, but the rain drove him back again.

"How about we go down the canyon?" Todd asked. "There's an actual trail there, and it's a straight shot down to the ranger station. Plus there's lakes and streams the whole way down. We can fish our way out."

"I thought your license was only good for tomorrow."

"Yeah. So we spend the night at one of the lakes. It'll probably take us the rest of the day to get there anyway. There's no trail between here and there."

"There's no trail *anywhere* from here," Doug pointed out.

"So we might as well take the easiest route back," Todd said. "All our bushwhackin'll be downhill."

Doug looked out at the storm. Todd followed his gaze, and saw the band of light in the eastern sky. The thunderstorm was moving on, but there would be more of them this afternoon. Hanging out on the ridge and hoping someone spotted them from the air would be a bad idea.

Doug either picked up his thoughts through the link or he was smart enough to figure it out on his own.

"All right," he said. "Downhill is good."

"To think," he said a couple hours later, "I gave up a weekend in Hawaii to doc your fishing trip."

"You recordin' now?" Todd asked. He didn't turn around. He was breaking trail, but Doug was right on his ass; they could hear each other just fine.

"Are you serious? Who wants to remember *sweat?*"

When they'd been soaked and shivering, neither of them could have imagined being too hot again today, but the sun had come back out and baked them dry—and continued to beat down on them without mercy. Todd was wearing out his forehead with the back of his hand, and his shirt was starting to get soaked again, too—this time from within.

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The first kilometer across the ridgetop had been a piece of cake, but as soon as they started down into the canyon they hit a wall of brush, and it was no easier to bull through on foot than it had been in the car. Even after they got into the trees again, the understory was choked with fallen logs and bushes and rock outcrops. The footing was treacherous even without sacks of provisions slung over their shoulders like Santa's toybag, but the awkwardness and the weight made them work twice as hard for every step.

All the same, the chest pain took Todd completely by surprise. It felt like he'd whacked into a tree or something, but then the pain shot down into his left arm and zapped his thumb and forefinger like a short in a virt-suit. His vision blurred, and his stomach gave a warning lurch like it was about to send lunch back up for a refund.

He dropped his bag and sat down on a log before he could fall on it.

"You all right?" Doug asked.

"Yeah, I—ow! No, maybe not." He rubbed at his chest, just under his left nipple. "Son of a bitch, that hurts."

"You're spammin' me, dude."

"I . . . wish I was." Now it felt like somebody was running a lit torch up and down his arm, except for his fingers, which had gone numb.

Doug dropped his sack and knelt down in front of him. "Oh, no. No! You can't be havin' a heart attack. Not here!"

"Good," Todd said through clenched teeth. "I was . . . startin' to get worried."

Doug stood up again and looked away, turning his head from side to side. He was trying to link with the web. Todd wished him luck. They'd been trying it off and on without success ever since they started walking, but maybe this time he'd snag some signal skip or something.

Or maybe not. Doug knelt back down and said, "What can I do?"

"Water," Todd croaked. His throat felt like a baseball had lodged in it. Doug snatched his canteen off his belt and handed it over, and Todd took a cautious swallow. It didn't help much, but it didn't make him hurt any worse, either, and it sure as hell couldn't hurt to replace some of the water he'd sweated out.

He took another swallow. The clamp in his chest seemed to ease up some, so he took another.

"That's better." He flexed the fingers of his left hand. The tendons or blood vessels or whatever still felt like they should be incandescent with the heat, but at least he could feel his fingers again.

"You gonna live?" Doug asked.

"Yeah." Todd concentrated on proving himself right, taking deep breaths and rubbing his chest and arm. The pain slowly eased. At last he said, "So that's what that feels like. Let me tell you, it's even less fun than gettin' hit by lightning."

"I know."

"You've had a heart attack?" Todd couldn't imagine it. Not Doug. Mister Exercise himself?

"No, no," Doug said, waving his right hand dismissively. "But you were broadcasting, and I didn't want to shut you down if it was your last gasp, you know?"

"Oh." That was more than he'd expected of him, actually. Then a thought hit him and he narrowed his eyes. "You didn't *record* that."

"Well, yeah," Doug said, "I was thinking last will and testament, you know? But if you're not going to snuff it just yet, I'll delete it."

"Yeah. Thanks." Once through that kind of agony was enough. At least it was short-lived. Todd kept taking deep breaths, and within a couple of minutes, he felt surprisingly good again. He tried standing, and that worked OK, too.

Doug stopped him when he reached for his bag. "Oh no you don't. You're staying right here until I can get you an ambulance."

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"Screw that," Todd said. "Even if you make it out, you'd never find me again in a million years. We've got to get down to the stream, at least."

Doug didn't like that idea at all. He turned once around like a tourist looking for an information kiosk, then suddenly said, "Wait a minute. Neither one of us has to go anywhere. It's dry enough now, we can start a fire. That'll attract somebody."

Todd shook his head. "It would if we could, but fires are illegal in the national forest."

"So we pay a fine. If it gets you—"

"I mean neither one of us brought any matches, and we don't have a laser or a camp stove, either. Unless you know how to twirl sticks or strike a spark off granite, we're not lighting any signal fires."

Doug frowned and kicked at the log Todd was sitting on, but at last he said, "OK, you're right, but you're going to rest for a good half hour before you even take a step, and you're not carrying anything when you do. Clear?"

It was a long half hour. It was an even longer two hours down to the stream, and an interminable fifteen-minute argument over whether or not to walk on down to whatever lake was next in the chain and see if they could find a camper with a weblink. At last Doug relented, mostly to keep Todd from blowing an artery over being pampered, but when they got to a rock-rimmed pond maybe fifty meters across, they found it deserted.

"That's 'cause this ain't a lake," Todd said. "Nobody wants to camp by a puddle. Hell, I could piss halfway across it."

"That's against forest regulations, isn't it?" asked Doug.

Todd chuckled. "Yeah, so it is." He looked at it again. In truth, it was a pretty nice little camp site, and the west rim of the canyon was already in shadow as the sun set behind it. It would be dark before they could make it to the next lake in the chain. Then he heard a splash out in the water and turned to see ripples spreading out from a spot just a few meters off the bank. "All right!" he said, "I stand corrected. Let's make camp."

They laid out the tent on a patch of grass across the trail from the water. It was still too close for regulations, but Doug insisted they be near enough to hear anyone walking by. "And if a ranger tries to give us a ticket, fine. At least he can call for help."

"I don't need rescuing," Todd said.

"Like hell you don't."

"I feel fine." He slapped himself on the chest.

It felt like he'd stabbed himself with a knife. His heart gave a twist that felt like it really meant business this time, and his legs buckled beneath him. He couldn't even raise his arms to keep from smacking his head on the ground.

"Todd!" He could hear a tent pole clatter to the rocks as Doug dropped it and came running.

He tried to raise himself up, but none of his muscles would obey his commands. It took a supreme effort of will just to breathe. Liquid fire poured though his entire body. He bit down on a scream, then managed to croak out, "Those . . . are the . . . stupidest last words . . ."

"Don't you die on me, you stupid shit!"

"Sorry. I don't . . . think I've got a choice."

His ears were ringing like a bad weblink, but he heard Doug say, "Core dump! Core dump!"

"What?"

"Uplink into my implant! It'll hold you."

Todd sincerely doubted if it would. Not even a partner-swapping sex rig could hold a person's entire psyche, but at the moment he didn't see that he had much choice. A thousand little dwarves with hammers and chisels were smashing their way through his body, and it wouldn't be long before they made it to

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his brain. He hated the idea of taking the pain along with him, but he didn't have time to edit; he just threw open the doors and spewed everything he could through the link before he passed out.

"We've got to hike out *now*," Doug said. It was different being in the same head with him. The implant was a completely separate system, but it used the same peripherals as Doug's natural brain: even though the body's lips didn't move, the input came in as audio, and Todd's response went out as voice.

"We'd trip on a rock and bust our necks," he said. "Or get lost and wander around for a week until *you* have a heart attack. Forget it. My body's already dead. Let's get some rest and walk out in the morning." It surprised him how dispassionate he could be about it, but he supposed that was an effect of being digitally stored. Another cool effect was the ability to edit; the pain that had blasted him down had been sent where laps go when you stand up.

"If we get help soon enough, we might be able to revive you!" Doug insisted. Todd saw his arms wave, then his head tilted down and he saw himself lying face-up on the ground. He looked . . . well, he looked dead, and smelled like it, too.

He looked away. "Hah. Body's already startin' to stink, and it's at least four hours to the trailhead. It'll be bear bait before we even get there."

"All the more reason to get the heck out of *here* then," Doug said.

Todd snorted. "Bears've got radio collars. One gets within sniffin' distance, we don't have to walk at all."

Doug fumed silently for a while, but he eventually gave in. Todd was right, and he knew it.

It took them a couple of hours to get used to sharing his body, but as long as they didn't both try to use the same muscles at the same time, they managed OK. While the Sun set and the sky turned from blue to red to purple, they opened a pack of self-cooking turkey dogs and washed them down with a can of beer, which turned out to be a disappointment to Todd. He could taste it just fine, but it didn't do anything else for him.

"Damn it," he said. "You'd think a guy who'd just croaked could at least get drunk afterward."

"Don't complain," Doug said. "If I hadn't had this implant you'd be croaked for real."

"Might as well be," Todd said. "It'll be years before I can get a clone up to age. I'll probably wind up in a parrot body 'til then."

"You don't have a clone in storage?" Doug asked incredulously.

"No." Todd felt the shame wash through him, and he almost deleted it, but he decided maybe he deserved to live with it for a while. It was pretty stupid not to have a backup in this day and age. He wasn't that old, and he'd thought he could get away with it for another decade or so and save the storage costs, but he'd gambled and damned near lost. Maybe a little shame would keep him from doing it again.

What an idiot. And right before his fishing day, too.

On the other hand, he was still here, wasn't he? And they didn't exactly have a pressing need to go anywhere at the crack of dawn, now, did they?

He reached over to the pile of equipment they'd carried with them and rummaged around until he found his fishing gear.

"What are you doing?"

"Puttin' together my rod."

"What the hell for?"

"I know there's at least one trout in that lake. I aim to catch him at first light."

"No way! I'm not going fishing with your dead corpse watchin' me from the bank. Besides, if they catch me fishing without a license, I'm screwed even worse than you."

"We've got a license. We got the body

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if they want a retina print, and I'll be running the arms here if they want to get technical. We're OK."

"OK? Jesus Christ, Todd! We are so fucking far from OK we couldn't find it with a goddamned map! You're *dead*. Can't you get it through your thick . . . well, I mean . . ."

"Yeah, yeah, I'm dead. Big deal. That's no reason to ruin a fishing trip."

Doug tossed up his hands in disgust, but Todd caught the rod on the way back down and finished threading the line through the guides. He took a white-winged Royal Coachman out of his fly box and tied it to the tippet, then tried a few practice casts. "Yeah, this'll do," he said. "You've got good arms."

"You're totally insane," Doug replied.

He was still singing the same song in the morning, but Todd noticed his ghostly presence in their arms when he made his first cast out over the lake. The Sun was just peeking over the flank of the round-topped mountain to the east, and mist rose off the water as the morning air started to lift with the first heat of day. The water's surface was mirror-smooth, except for the single ripple where the fly had hit.

"Here, fishy, fishy, fishy," Todd whispered.

"Oh, give me a break," Doug grated.

"Hey, everybody's got their rituals."

Doug didn't reply. Todd tugged the fly into the air, whipped it behind him, then cast again a little to the left. Nothing struck at it this time, either, but he heard a splash and saw a ripple spread from the other side of the lake.

"Think you can hit that, hot shot?"

"Maybe." Todd cast again, stripping out a little more line as he did. "Let's see." He let the fly settle and waited a few seconds, then stripped out another couple of meters and cast again. It was like riding a bicycle; you never forgot how.

He had a pretty good stretch of line out, but his rod was a nine-foot spun diamond; it had flex enough to load the whole reelfull if he could keep from snagging it in a tree or looping it back on itself. He was already reaching three-quarters of the way across the lake. Just a couple more casts and he'd land the fly right on target.

But Doug had to get in on the act. Just as Todd whipped the line back, he felt the ghostly extra hand beside his own, and he twitched just enough to send a ripple down the line. He snapped his wrist forward, but it was too late: the line bellied out and lost its tension, then came flying forward in a huge snarl that slapped into his back and draped over him like a net. He felt a sharp sting in his right earlobe and reached up to find the fly hooked there, the barb all the way through the flesh.

"Ow! Damn it! That's my *Why don't you keep your goddamn* earlobe! *hands out of my business!?*"

"*Your* business? It's my body!"

"Serves you right for messing with my cast. Hold still." Todd pinched the earlobe hard with his fingers and with one quick tug yanked the fly out. Doug tried to stop him as soon as he realized what he was doing, but it was too late.

"Ow! Damn it, you could have at least mashed the barb."

"Jesus, how long has it been since you've fished? Flies don't have barbs anymore. Just a bump to keep 'em from falling out." Todd held the Coachman up in front of Doug's eyes so he could see the thick spot just behind the point. The white wings were tinged red with blood, and the iridescent green body was soaked in it.

"Gah," Doug said. He tried to toss it in the water, but Todd stopped him.

"Blood is good. It'll attract the fish. Wait 'til I'm ready."

Doug gurgled something incomprehensible, but Todd ignored him. He reeled in the snarled line, then started false-casting, whipping the fly forward and back without letting it touch the water, stripping out more line each time

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until he had enough to reach the middle of the lake. Then he snapped it forward one last time and let it settle gently through the rising mist onto the water.

Nothing. No ripples anywhere, except for the ones from the fly and the line. Todd gave it a few minutes, but when the fly started to sink, he pulled it back and cast again.

"Give it up," Doug said. "You're not going to catch anything."

"Says you."

"Yeah, says me. It's my body you're using, and I'm getting tired of hanging out here with my metaphorical thumb up my metaphorical butt while you waste time trying to prove what a hot-shot fisherman you are."

"Oh, come on. I just got started. Give me a chance here."

"No. It's time to go." Doug took control of the arms and started to reel in the fly, dragging it across the water like a boat under tow.

"Stop it! You'll spook the fish!" Todd struggled to whip the fly out of the water, but with Doug still grappling for control he managed to yank it straight at his face. Instinct made both men throw their hands up to ward off the incoming fly, but it managed to slip past their fingers and slap them on the nose before it fell to the ground at their feet.

Doug picked up the rod and held it in both hands, ready to bring it down on his knee and snap it in two, but Todd fought him, and slowly Doug let up the pressure.

His voice was cold as ice. "All right, buddy. You want to catch a fish? Let's catch a fish."

He turned away from the lake and set the rod on the bank, then walked across the trail to their camp, taking out his pocket knife on the way. When he got to Todd's body, he bent down next to the head, and before Todd could react, he sliced off Todd's right earlobe.

"Hey!" Todd winced with sympathetic pain, but in fact he had felt nothing.

"Hey what? You want to catch a fish; well, this is *you* catching a fish." He marched back to the edge of the lake, picked up the Coachman, and stabbed the hook through the earlobe. Then he reeled in about half the line, whipped the rest behind him in a passable backcast, and lobbed it out into the water. It made a soft splash when it hit. Not bad, Todd had to admit. Just enough of a disturbance to attract the fish's attention, but not enough to spook him.

Still. His earlobe! "It's illegal to use bait," he said. "Not to mention desecrating a corpse."

"So sue me."

They stood there on the bank, fuming and fishing, while the last of the steam rose off the water.

"He's not going to take it."

"Give him time."

"So now you're the one with all day to kill?"

"I don't want you to go home empty-handed. I'd never hear the end of it if you did."

"Oh, come on, I'm not that—"

There was a swirl of silver, and the line twitched.

Todd tugged at the wrist, but Doug held it firm. "Don't set it yet!"

"I know how to catch a fish."

"Yeah, with a fly. This is bait. Let 'im swallow it."

"He'll spit it out as soon as he realizes what it is."

"It's meat. He'll eat it."

The line pulled tighter, loosened, then tightened again. "Now!" Doug said, just as Todd could take it no longer. They both yanked back on the rod at the same time, and a silver rainbow trout the size of their forearm arched out of the water, shaking its head against the sideways tug in its mouth.

"Got him!"

"Let me do it!"

"No, it's my ear; let me do it."

"Fifty-fifty. You take the pole; I'll reel."

"All right."

The fish rose again. Together, they played it toward shore. ■

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BRANE BASHING: BIG BANG OR BIG CLAP?

The Big Bang scenario with inflation is the prevailing standard model of cosmology, the theory that best accounts for the origin and evolution of the Universe. It describes the early Universe as arising from a singularity that at first expanded exponentially at super-light speeds, then slowed to the more moderate expansion that we presently observe. It has some problems that will be described below, but it is the best theory we have, and it fits the observations.

However, in the past year a new alternative to inflationary Big Bang cosmology has been proposed that is receiving considerable attention. It is called "ekpyrotic cosmology," and it describes an early Universe in which there was no Big Bang at all, but instead a collision of higher-dimensional "branes."

This new cosmology uses as its starting point recent work on millimeter-scale gravity (see my column #98, "Millimeter Gravity and the Superstring Wall," in *Analog*, December 1999) that comes from "M-theory" (what the physics community used to call "superstring theory"). The millimeter-scale gravity ideas describe each 4-space location in our Universe as confined to a thin extra-dimensional "D-brane wall" on which the strong, weak, and electromagnetic interactions are confined, while the gravitational interaction is allowed to expand away from this wall in two or more extra dimensions. Gravity, in this picture, is weak because most of its lines of force are dissipated into these extra dimensions. The other three forces, because they are confined to the D-brane wall, are not similarly weakened. Here the word "brane" is derived from the word "membrane" and means a thin membranelike planar structure embedded in a multidimensional space.

This new *ekpyrotic* cosmology derives its name from the ancient Greek stoic philosopher's notion that the Universe was cyclically destroyed and recreated by fire. It suggests that our Universe originated from the fiery collision of two of these "branes." In other words, our Universe, which perhaps had been cold and featureless for an indefinite time, was struck by another brane, like two hands coming together to produce a Big Clap. The effect of this collision of branes was to produce the energy, matter, and structure that we find in the present Universe. In this scenario, the Universe did not begin with an infinitely hot Planck-scale singularity. Instead, it started at a finite size and temperature that was initially static, but after the collision, it expanded.

To understand the implications of these new ideas, let's begin with a review of what is presently the "standard model" of cosmology, the inflationary Big Bang scenario. The simple Big Bang model describes our Universe as having exploded from a "singularity," a point-like region of space that was supersaturated with energy, forming an ultrahot ultradense medium in which the gravity was so strong that it curved space back

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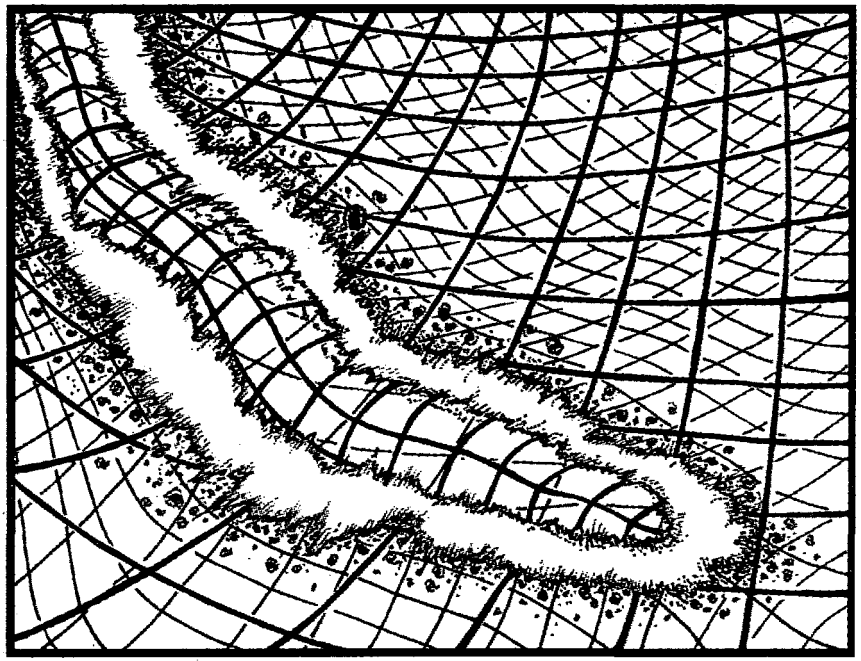

Illustration by Wolf Read

on itself in a distance of about 10^{-34} m. As the Universe became larger, it cooled from its ultradense, ultrahot origins. The fundamental interactions sorted themselves out into the strong, weak, electromagnetic and gravitational forces. The resulting mixed soup of matter, neutrinos, and radiation cooled and separated, and the components went their separate ways. The radiation component we see today as the cosmic microwave background. The matter congealed into dust clumps that became galaxies. Stars formed, exploded in supernova violence, and formed again, repeatedly recycling matter into heavier elements. Planets formed around some of the stars and became infested with life. We came along very late in the game to try to piece together all that had previously happened. The result is what we call the Big Bang.

However, this simple version of the Big Bang model has a number of problems which are called the problems of *homogeneity*, *flatness*, *inhomogeneity*, and *monopoles*. For example, a hypothetical observer looking at the sky immediately after the Big Bang would see the horizon of the visible Universe (the distance at which light is Doppler shifted to zero energy) only about 10^{-34} m away. Immediately after the Big Bang, each spatial region of this size became causally disconnected from the many other similar regions. Today, however, the horizon of the visible Universe combines 10^{90} of these disconnected regions, some of which are only now coming into causal contact with the rest of our Universe. There is no particular reason why these 10^{90} regions should resemble one another at all, yet we know from the COBE microwave background measurements that they vary at most by one part in 100,000. The remarkable smoothness of the Universe is a fundamental mystery. Why are the 10^{90} independent pieces of today's Universe so similar? This is the *homogeneity* problem.

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The *flatness* problem is raised by the remarkable lack of curvature, either positive or negative, of the present Universe. There is a nearly precise balance between the expansion energy and the gravitational pull on the Universe. Gravity and expansion are within about 1 percent of perfect balance. The *inhomogeneity* problem concerns the origins of the structure observed in the cosmic microwave background radiation and in the large-scale structure of the Universe. The *monopole* problem concerns the observed absence of magnetic monopoles in our Universe, when they should have been produced in great numbers in the early Big Bang.

The currently accepted solution for these problems, the "inflation scenario," assumes that in the very early stages of the Big Bang, for reasons not well understood, the Universe expanded at an exponentially increasing rate, with the radius growing much faster than the speed of light. The problem with the inflation scenario is that while it cures the ills of simple Big Bang cosmology, it seems rather contrived and raises unresolved questions of its own. (See my column #94, "Before the Big Bang," in *Analog*, March 1999).

The problem with the inflationary scenario is that it is "put in by hand." In other words, it is inserted into the theory without explanation or physical mechanism in order to solve certain problems. The origin of the enormous force that produced the exponential expansion is not explained, nor is the requirement that it operated for a time and then stopped. Further, the inflationary Big Bang model compels us to try to understand the laws of physics at the Planck Scale near the initial singularity, where energy densities are so enormous that we have no usable theories and no potential experiments.

The ekpyrotic scenario provides an interesting alternative to inflation. It describes our Universe as a "visible brane," the D-brane hypersurface that we live in and experience. It also hypothesizes the existence of a nearby "hidden brane," another Universe on a D-brane that is parallel to ours, but separated at a constant distance from our Universe across two or more of the extra dimensions. Initially, perhaps for a very long time, the visible brane remains cold, static, and empty. At some time, however, the hidden brane sloughs off a lighter "bulk brane" which travels across the extra dimensional separation and violently collides with our visible brane. There are ripples in the bulk brane, so that the collision happens at slightly different times in different regions of the visible brane. There are gravitational and other forces acting between the branes before and after collision, and these cause the length scale in the visible brane to contract before the collision and expand after the collision. This shrinking, collision, and expansion produced the expanding Universe that we presently observe.

The colliding branes are initially flat (in the sense of space curvature) and this flatness is retained by our Universe after the collision. The ripples in the bulk brane produced the balance between homogeneity and large-scale structure that we presently observe. And the ekpyrotic Universe, even at the instant of the Big Clap, was never hot enough or close enough to a singularity to produce the flood of monopoles that the simple Big Bang model predicts. Therefore, the ekpyrotic scenario deals with all of the problems of the simple Big Bang scenario without invoking inflation. It has the advantage that no Planck-scale physics or mysterious forces that switch on and off are involved. It becomes identical to the Big Bang model at some extremely high temperature, so that the subsequent evolution of the Universe, in particular the differentiation of the four forces, the synthesis of light elements, and the production of the background radiation, is the same in both models.

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The crucial test of any theory is whether it makes predictions that can be tested experimentally. In the present case, the question is whether there are tests that can distinguish inflationary cosmology from ekpyrotic cosmology. The answer seems to be "perhaps." The main differences between the models are in their production of primordial gravity waves. Inflation tends to produce a "red" gravity-wave spectrum that decreases in strength with decreasing wavelength, while ekpyrotic cosmology produces a "blue" gravity-wave spectrum that increases in strength with decreasing wavelength. Therefore, a study of the primordial spectrum of gravity waves would be a crucial test of the models.

Unfortunately, theses effects are too small to be detected by the NSF's LIGO gravity detector that is now coming into operation in Louisiana and Washington State, or by the space-based LISA detector project planned by the European Space Agency. The remaining possibility is the detection of optical polarization in the cosmic microwave background radiation induced by long wavelength gravity-wave effects. If such polarization were detected, it would tend to support inflationary cosmology and to falsify ekpyrotic cosmology. However, no such polarization has yet been observed.

Finally, since this is a science fiction magazine, let's consider the science-fictional applications and implications of this new cosmology. If our Universe was indeed produced by a collision with a traveling brane in a Big Clap, there's no particular reason why that would happen only once. That has the makings of a Universe-scale disaster scenario, with unexpected forces first detected weakly, then building up as the bulk brane approaches our Universe through the extra dimensions. The Clap when the branes collide would restart the Big Bang and bring an end to all life and civilizations that did not have an extra-dimensional escape hatch.

Another scenario might involve travel to another brane, a parallel Universe that is separated from ours only by a small distance in the extra dimensions (as in my hard SF novel *Twistor*.) Are there many of these brane Universes? Would each brane-Universe resemble ours, or would it be different? Are its laws of physics the same? Is it dominated by matter (as is ours) or by antimatter (a convenient energy source if one could fish some antimatter across the inter-dimensional gap)? Does time run in the same direction? Is the speed of light the same, or can one go faster over there and then return to our Universe at a different location? Do the other branes contain stars? Planets? Life? Civilizations?

All of these questions depend on whether the Big Clap of ekpyrotic cosmology and M-theory actually describe our Universe. Stay tuned for further developments.■

AV Columns On-line: Electronic reprints of over 100 "The Alternate View" columns by John G. Cramer, previously published in *Analog*, are available on-line at: http://www.npl.washington.edu/av. Preprints referred to below are available at http://xxx.lanl.gov.

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The Diamond Drill

Charles Sheffield

"If it looks like a duck and quacks like a duck. . . ." But how many tests are enough?

I doubt if there is a human being alive who said, as a small child, "What I want to be when I grow up is a tax inspector."

That includes the Customs official (Customs are just another form of taxation) who had just pulled me out of line with a discreet, "If you wouldn't mind, sir."

"What's the problem?" I had been headed for the NOTHING TO DECLARE exit.

"Your luggage. You are Dr. Purcell, arriving from Pavonis Six?"

"I am." I read his badge. "What can I do for you, Mr. Warren?"

"Are you aware, sir, that the import to Earth of diamonds, alien artifacts, and life-forms from Pavonis Six is strictly forbidden?"

"I did know that, yes."

"Then what about these, sir?"

We had entered an official chamber off the main entrance corridor. There, open on a table, lay my suitcase. Beside it sat a large leather pouch, also opened to reveal a bright glitter from within.

I laughed. "Oh, I see why you are worried." I put my hand into the pouch and pulled out a handful of faceted stones that seemed to catch and refract every ray of light in the room. "These are stage jewelry, Mr. Warren. They look much like diamonds, but they're not. I picked them up very cheaply, practically for nothing. If you like, I can show you the receipt."

"I think, Dr. Purcell, that we would rather obtain our own assurances as to their nature." He stared at me, but my easy confidence must have somewhat persuaded him of my innocence, because his voice was more friendly when he said, "I presume you would not object to our conducting our own tests—nondestructive ones, of course."

"Not at all." I quickly poured the handful of stones that I was holding back into the pouch and held it out. "I hope this won't take too long—I do

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have appointments."

"It will be very quick, sir, just a few minutes. We now have a fully automated procedure." He said that with a slight air of pride.

"A machine?"

"That is correct. This machine." He walked across to a compact unit maybe half a meter on a side. "It is designed specifically to establish if a stone is a diamond, or some other material."

He emptied the pouch into a hopper on the top, and the stones vanished into the interior.

"Fascinating." I leaned against the table. "If it's not some sort of trade secret, I wonder if you would mind telling me how it works."

"Not at all." From his tone I could tell that he was delighted to talk about his department's latest toy. "How much do you know about diamonds, sir?"

"Enough to know you can't buy them for the price I paid for those stones. Oh, and if it will scratch glass, it's a diamond. Right?"

"Actually, sir, that's wrong. Diamonds are the hardest things found in nature, but many other gemstones, such as rubies and sapphires and topazes, plus many manmade materials, will scratch glass. You would be safer to state it the other way round: If it *won't* scratch glass, it's not a real diamond."

"So I know even less about diamonds than I thought. This machine tests hardness?"

"It does. It also tests for *density*. Diamonds have a density of about 3.5 times that of water. Zircons—a very common 'fake diamond'—are much denser, at 4.6 and 4.7. So are rubies and sapphires at about 4.1. Glasses are much less dense."

"I suppose the machine tests everything for densities?"

"Indeed it does. But that's not all—colorless topazes have almost exactly the same density as diamonds, so we have to consider still another test: of refractive index."

"How much the stone bends light?"

"Exactly. Diamonds have a very high refractive index, at 2.43, which accounts for its brilliance. 'Fake diamond' candidates run over a wide range of refractive indices, from clear quartz at about 1.5 to zircons at 1.97."

"And I suppose this marvelous machine tests that, too?"

"Indeed it does. Only if a stone passes all three tests—hardness, density, and refractive index—can it be a diamond." The machine at his side beeped gently and disgorged a heap of glittering stones into the pan at its bottom. "And yours didn't pass all the tests. Whatever these are, they're not diamonds. I hope you didn't pay too much for them, sir."

"Oh, I don't think so." I picked up the pan and emptied its contents back into my lead-lined carrying pouch. "Is there anything else, Mr. Warren, or am I free to go?"

"That's all, sir. Welcome to Earth, and I hope that you enjoy your stay here."

"I'm sure I will. And I guess I won't be going near the diamond merchants."

We both laughed. I placed the pouch containing dozens of pure diamonds back in my case, nodded to him, and headed for the exit. The Customs staff were of course free to question me about other matters, but human psychology being what it is, there was no chance of that. Their infallible machine had assured them that despite the anonymous tip (provided, of course by me) Dr. Purcell was not a diamond smuggler, so it was remotely unlikely that he would be smuggling anything else.

The trouble with machines, of course, is that they do what they are built to do. They lack the human talent for suspicion or the power to notice that, although a stone failed to pass all their tests and could therefore not be a diamond, there was still something highly odd about the results of these particular tests.

My diamonds had satisfied the hardness test and the refractive index test,

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but they had all failed the density test. Their density, rather than being 3.5, would have measured 4.1. All diamonds are pure crystallized carbon, and these were no exception. But nothing like these diamonds had ever been found—or made—by humans. Ordinary diamonds consist of the commonest form of carbon, carbon-12. These were pure carbon-14, a more massive and slightly unstable isotope with a half-life of 5,700 years. If the Customs' Department machine had possessed a suitable test, it would have discovered that the stones were radioactive enough to glow feebly in the dark.

I was telling the exact truth when I said that I would not be visiting the diamond merchants. My target is the big industrialists. The chance to experiment with and explore an alien artifact is worth thousands of times as much to them as any gemstone in existence. ■

*

Addendum to

BEYOND THE PERIODIC TABLE: ARTIFICIAL ATOMS AND PROGRAMMABLE MATTER

by Wil McCarthy

Several people have pointed out that joining quantum dots in a semiconductor substrate, using covalent bonds alone, cannot result in a material stronger than the original semiconductor. Still, diamond is a semiconductor, and there are other forces (especially magnetism) which show promise in the reversible toughening of materials. I think it's safe to say that the promise of these technologies will be fullfilled in some very surprising ways.

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You probably didn't know about this early venture into space. . . .

The History of Chan's Journey to the Celestial Regions

Richard Foss

Illustration by Kelly Freas

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The elderly man in threadbare scholar's robes picked up his cup of tea and sniffed, enjoying the scent of jasmine. "Chan Ji-Lin has decided to go to the Moon," he announced to his companion.

"Humph. It is just what I would expect of him," growled his even older companion. "The aristocrats these days are always coming up with new ideas, with no time for the old rituals and observances. Comes from reading too much Taoist poetry, no doubt."

"As always, your clarity of sight is worthy of an eagle. He has worn out another scroll of Li Po's late works just this week, and has been reading Tao Yuan-Ming until a new copy arrives from the bookseller. There are many references to the beauty of the Moon's reflection in Pine Tree Lake in them, and perhaps that is where the idea has come into his head."

"Li Po," the old man snorted. "I remember Li Po, drunk half the time and dallying with courtesans and artists when he was sober enough to walk. Dreadful example to youth. Terrible calligraphy, too!" He snorted again, as though the last offense was worst of all.

The old scholar raised his cup of tea to his mouth, as much to enjoy its fragrance again as to hide a smile. "I remember him too. Were my poetry esteemed enough that courtesans would pay to spend time with me, as they did with him, I should count myself a lucky man indeed. But alas, I am old now, and dream neither of courtesans nor of flying to the Moon, only of a body that does not creak when I stand up."

"Had you spent less time in dissolute company and more practicing proper Confucian rituals to honor your ancestors, you would be both healthier and wealthier." The old man bowed his bald head over his tea and muttered an invocation, then sipped. "The Moon, you say? How will he get there? A chariot drawn by magic swans, perhaps?"

The scholar sipped his tea without benefit of a prayer and smiled gently. "Chan Ji-Lin would happily use the services of magic swans or dragons of the air, but he knows of no one who has actually seen either. He is planning on using the new weapon which the forces of the great General Wu launched against the Mongols. It is called a rocket."

The old man snorted again. "New ideas everywhere, impiety everywhere." He moved the bronze teapot closer to the charcoal brazier. "Taoists everywhere." His friend the Taoist scholar smiled behind his own cup of tea.

Fang Hong, the master fireworks maker, squinted at the complex diagram on the scroll, then shook his head in the negative. "The ones we make for the Emperor's arsenal have a long stick on the back to help them fly straight, but no such thing as this. How did you get the idea?"

Chan Ji-Lin pointed manicured and lacquered fingernails east toward the sea. "The oceangoing junks that go to faraway lands, to Hainan and Nipango, have just this sort of rudder for steering them. They use hemp rope to guide it, but horsehair will be lighter and stronger, better for my purpose."

Fang Hong shook his head again doubtfully. "What about this, this stacking of one firework on another firework?"

"I call it 'the snake shedding its skin.' When the fuel of the first rocket is fully burned, the fuse spreads the fire to the next rocket, and the large firecrackers blow the previous stage away. The craft will get lighter each time, more steerable just as a small junk is more nimble in shallower waters. The Moon will have pleasant meadows ringed by tall pine trees, and I will need to steer for one of those." His eyes misted over. "I will land in the celestial paradise, slowing myself by way of kites I have tested in the winds of the Three Gorges. Last year a gust of wind hit my largest kite, and it picked me up from the ground. I had to

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let go of the string to keep from being pulled off the hill where I stood."

The fireworks maker looked puzzled. "If the wind might pick you up and take you to the Moon, why risk this curious and dangerous vehicle?"

"The wind might take me anywhere, but it is the Moon I must visit." He lifted his cup of tea, found it empty. Fang Hong shouted and an apprentice ran outside. The fireworks maker turned again to the young aristocrat.

"My apologies that your cup is dry. I will have more tea in a moment. I allow no fire here, for obvious reasons, so we draw water from a stone jug that is heated in the blacksmith's forge all night."

The young man returned and offered tea with great formality, but his eyes were on nothing but the drawing. After a moment he spoke. "Wouldn't it be a good idea to put a small rocket here on the side, in case you needed to steer hard in one direction? You could put it on an iron swivel and operate it from inside."

The master fireworks maker raised his hand to cuff the apprentice, but Chan Ji-Lin seized him by the shoulder. "Yes, a perfect idea! See that it is done. I will pay extra. Now what do you think of this control method?"

The young man bent over the drawing eagerly. "The ropes should be in bronze tubes, so that if dragons breathe fire in your path, the horsehair will not singe."

"A sensible precaution, indeed. What is your name?"

The young man bowed low. "I am called Ho, of the humble family of Kang, and it would be my greatest pleasure to help you with your skyfaring vessel."

The Mandarin who ruled the district tugged at his impressive goatee and squinted at the messenger, who kowtowed again. "This Chan Ji-Lin is of a good family?"

"Of the best, your excellency. Their fortune is old and honestly acquired, the peasants on their lands well treated, the servants in their employ respectful to their betters. Except for his fascination with the Moon, Chan Ji-Lin himself is the model of respectability."

"And the . . . thing he is building—will it work?"

"Excellency, it is hard to know. Since Kang Ho the firework maker's apprentice became Kang Ho the rocket builder, many things have changed. Whatever happens, much has been learned already. The new rockets they have been testing fly straighter than the old ones in the Emperor's arsenal, and they are far more reliable. Besides this, Chan Ji-Lin has set his servants to building kites in which a man may rise into the air and view the countryside around. Such things may help in the war against the Northern barbarians."

The Mandarin thought about this for a moment, then dismissed the messenger. He clapped his hands twice, and a servant stepped into the elegantly furnished room. "Send in a scribe," he ordered. "I have a message to go to the Emperor himself."

Kang Ho shook the tradesman roughly. "This lacquer is of the second quality, and we have ordered the first! The outside of the skyfaring vessel must be smooth and perfect in color so that the celestial inhabitants will admire the works of our own sphere!"

The lacquer-seller stood to his full height and looked down his nose at Kang Ho. "I will have you know that my lacquer is good enough for the shields of the Emperor's army."

Kang Ho sneered. "Good iron is not used to make nails, nor good men to make soldiers. Nor apparently is good lacquer used to make their shields!"

The lacquer-seller's reply was interrupted by a servant's voice. "Rocket Builder Kang, there is delegation here to see you."

"A delegation? From where? Why?"

"The merchants of the city, the

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wealthiest ones. They are in formal robes, and they bring gifts."

"Offer them the best hospitality we have, and I will be there in the merest moment." He glared at the man he had been arguing with. "Perhaps there will be one among them who knows the difference between lacquer and mud."

The chief of the delegation was Master Li, whose family was so old and renowned that it was said they had sold silks and sandalwood to the legendary Yao Emperor. It was therefore something of a surprise when that elegant worthy addressed Kang Ho in the style reserved for an equal. After many pleasantries and the ritual questions about the health of each other's parents, they finally got down to business.

"We of the local merchants' guild naturally seek to enhance the prosperity of our district, and we have been following your activities with great interest. Is it true that the vessel you are building for Chan Ji-Lin is superior to any which may be found in the Emperor's arsenal?"

"The Emperor's generals have used their rockets only to frighten the barbarians of the North, and to deliver fireworks to such a height that the Emperor may appreciate them. While this has been useful indeed, much more could be done with them. My patron the worthy Chan Ji-Lin is taking several brushes, three fine inkstones, and some parchment with him on his journey to the Moon, so that on the way he may draw a most accurate map of the Imperial dominions. He should be able to see the cities of the barbarians, and where their armies are quartered. Such a map will be of great use to the Emperor's officials, so that they may send trading expeditions where they will be most needed, and they may avoid the forces of the Mongols."

Master Li pondered a moment. "A worthy project indeed," he mused after a pause. "One detail intrudes, however. The map may be most fine and accurate, but at the time of its completion it will be on the Moon with its maker, while the Emperor's officials will all be here."

"This question has been considered. The lunar vessel will have no less than eight carrier pigeons aboard, so that messages may be sent back and forth to the Moon."

Master Li nodded sagely. "You have indeed thought of every detail," he said approvingly. "I will tell you that we of the local merchants foresee great things from your project, and we are most eager that you should continue your efforts after your wise and worthy patron departs for his voyage. The Emperor's armies are sure to clamor for these improved fireworks . . ."

"Rockets," interjected Kang Ho.

"Pardon, rockets," Master Li agreed. "In any case, much wealth might flow from the Imperial capital to our humble district, to the betterment of all who live here. I have been told that the Emperor's generals have ordered several hundred war rockets of the old type to repulse the Mongols. Wu the bronze founder has been estimating how many catties of silver the Emperor might pay, were we to make that many of the type you are building now. He became so excited that he was quite delirious, and he had to lay down with a cool cloth on his forehead for some time."

Kang Ho frowned. "I have not considered the financial implications of this, I confess. I have put all my effort into designing the perfect vessel for my worthy patron, who travels for reasons that have nothing to do with money."

Master Li smiled a fatherly smile. "It is well that you should concentrate on these things, for his safety is in your hands. If you will allow me to assist you in these matters, I can assure you of sufficient wealth that you will be able to build moon vessels for the rest of your life and never worry about money."

Rocket Builder Kang smiled at the thought.

* * *

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The Chief Mandarin of the Empire read the letter again, then looked at the man who sat comfortably in his private chamber. "Might this be done?" he asked quietly.

The Chief General took a moment to answer, distracted as he had been by the scent of flowers from the immaculately maintained garden outside. "It may indeed be done. Whether the fellow who does it will come down alive is another matter."

"Can you guarantee that the person who does it will not come down alive?"

The Chief General stared absently at the letter, which he had already read. "Rudders," he muttered. "Little rockets to steer with. Kites to land with. Carrier pigeons, a nice thought there." He shook his head. "He seems to have thought of just about everything. No, it is an act of madness, of moon-madness, but it may work."

"I thought so," said the Chief Mandarin confidently. "In that case, the Son of Heaven must be told of this endeavor."

"Why?" asked the Chief General.

The Chief Mandarin looked at him in astonishment. "Imagine the insult to the Emperor of the Moon if a visitor comes from Earth without a letter of greeting from the Emperor of China!"

"Ah," nodded the Chief General. "I hadn't thought of that."

Emperor Tang Ming-Huang sat in the gathering dusk with a flask of warm rice wine by his elbow. The cool breeze brought the sound of the distant singing girls and pi-pa players who performed at all times, on the off chance that he might be listening. He heard the song without listening to it, drank the wine without tasting it, for his thoughts were on the sky. As he watched, a cloud scudded past the Moon, partially obscuring it. A tear rolled slowly down the Emperor's cheek. He had thought himself at the peak of humanity as the ruler of the greatest kingdom in the world. It was a frightening thought, that he now had all that could be worth having. It threatened a lifetime of boredom and ennui. Now a mere subject, a country gentleman who had to be at least half mad, had reminded him that there were new dreams to dream after all. Such a man would have to be rewarded properly.

He took up a blank scroll and began to write in strong, graceful characters, a wide smile on his face.

Chan Ji-Lin turned the beautifully polished piece of bronze over in his hands, eyeing it with some bewilderment.

"I don't remember specifying that the steering rocket nozzle should be modeled in the shape of a dragon's head," he ventured uncertainly.

"And I didn't ask for them to be made that way, but the artisans at Master Li's shop insisted on it," explained Kang Ho. "The Moon people must see that the workmanship of the bronze founders of our celestial plane is the equal of their own."

"Appearances are important," Chan Ji-Lin agreed. "But staying within our budget is even more important. I have pawned my family heirlooms and mortgaged my home so that this vessel might be built. Now it is half complete, but three-quarters of my money is spent. At this rate, I will not be able to afford to finish it!"

Their conversation was interrupted by a blast of trumpets from the street outside, followed by an excited hubbub among the servants and apprentices in the front of the workshop. One young apprentice ran over to the two men and bowed low.

"Most excellent Patron Chan, worthy Rocket Builder Ho," he stuttered with excitement. "There is an imperial messenger waiting outside for you!"

The two men rushed to the street, where eight trumpeters and a group of armed men on horseback surrounded a man in a palanquin who wore the red robes and black hat of a high mandarin.

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The official drew himself to his full height and addressed the two of them sternly as they kowtowed in the street before him.

"I bear tidings from the Emperor himself for Chan Ji-Lin!" the mandarin proclaimed in tones that rang across the gathering crowd.

"I am that unworthy person," answered Chan, bowing again.

The mandarin pulled a scroll out of his sleeve, sealed with the yellow ribbon which was reserved for manuscripts written in the Emperor's own hand.

"The Son of Heaven has appointed the honorable Chan Ji-Lin as his ambassador to the Emperor of the Moon, and gives him this scroll of greeting to present upon arrival at the court of that august ruler, his brother on the Moon!" The trumpeters blew another salute that was almost drowned out by the buzz from the crowd. Chan Ji-Lin stood dumbfounded for a moment, then started forward to receive the letter.

"The Son of Heaven sends his ambassador silk of the finest quality for a garment as befits an ambassador, and sends gifts to be distributed at the lunar court! He also aids his ambassador on his journey with this grant of five catties of gold for the construction of his vessel!"

Kang Ho groaned slightly as a chest of gold was lugged forward by two strong men. Now that everyone knew that they had this money, they would never pay less than twice what anything was worth.

The small sound seemed to draw the attention of the mandarin. "Do I now address Kang Ho, known as Rocket Builder Kang?" he bellowed.

After Kang Ho bowed low, the mandarin pulled another letter out of his sleeve and held it forward. "The Son of Heaven confers on you the title of Imperial Rocket Builder, and directs that you act with all diligence to complete the celestial vessel!"

In a lifetime of bowing to the commands of authorities, Kang Ho had never bowed lower or more sincerely.

The mayor of the district was fawningly humble as he addressed the new ambassador to the Moon, who was being fitted with a robe of the finest red and purple silk.

"Would the most worthy ambassador assist this lowly servant of the Emperor by estimating how much gunpowder will be used as fuel for the celestial vessel?"

"As ambassador, I am not much involved in such technical matters, but I believe it is around two hundred tons," answered Chan Ji-Lin absently. "Or maybe Kang Ho said three hundred. I don't remember."

The mayor's forehead suddenly developed a sheen of sweat. "If the most worthy ambassador would consent to move the celestial vessel to somewhere outside the city limits, I believe some excellent terms may be arranged. There is a fine piece of land just the other side of that range of hills, with excellent feng shui for beginning a journey . . ."

Chan Ji-Lin listened with half an ear and directed the man to speak with Kang Ho. As the mayor departed, the tailor who was fitting his new garments whispered, "He calls that a formal robe? Really, that style has been out of fashion since the second year of the Sui dynasty."

Kang Ho eyed the piece of black bamboo warily, but it was all the little Sichuanese hillman said it was. "You can get me a hundred pieces just like this, as tall as three men, the width of two thumbs, and straight as an arrow's flight?"

"Straighter than an arrow's flight, if it is me shooting the arrow," the little man affirmed with a wide grin and the latest in a series of bows. "I do not know archery, but I do know bamboo, and I know a perfect grove in which I may cut five hundred such pieces."

"In time, I may need five hundred, but

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right now one hundred will do." Kang Ho sighted down the length of the bamboo again. "The ambassador's cabin will be made of this bamboo, so it must be light and strong. The very life of the Imperial Ambassador will depend on the quality of your work."

The hillman bowed low. "Imperial Rocket Builder Kang, I will have them delivered within a week!" The small man ran back to the donkey cart he had arrived on and flipped the reins. The animal brayed in protest, then reluctantly trotted away.

Kang Ho watched him go for a moment, smiling. It had not been as bad as he had feared. The local tradesmen were so in awe of him that he was actually paying less for better merchandise than he ever had before. The shipment of lacquer he had just received was so clear he had been able to see every detail of the bottom of the barrel as soon as he removed the lid. He gazed into the distance, reflecting on his good fortune, then started slightly as someone cleared his throat nearby.

"Pardon, Architect Wu, I had not heard you come near," exclaimed Kang Ho. "How is the work on the collapsible pagoda coming along?"

"Not truly a pagoda, Imperial Rocket Builder Kang, more properly a rather elaborate scaffold," corrected the architect in a high, reedy voice. "I have figured out a design which will hold the grand rocket steady until the moment that it begins to lift into the sky, but will then fold away so it may be used again upon the next instance that a voyager requires it."

The two men looked at the huge first stage of the rocket, which was receiving the attentions of a team of painters who decorated the sides with sinuous imperial dragons. "It will be most wonderful, most beautiful," said Wu the architect softly. "Though I understand that this part will be shed soon after the journey begins. Are you not worried that it will fall on someone's cottage?"

"We will launch to the east, so that this part will fall in the ocean. The only life at risk will be that of the ambassador." And mine, he added to himself silently, remembering what happened to Imperial servants who failed in their duties.

"Strange that this small height can make giddy one who is soon to ascend so much higher," mused Chan Ji-Lin as he stood at the top of the gantry. The summer breeze freshened a bit, but the huge structure only creaked slightly.

"Last year I would have thought it a wonder to look down upon the birds in their flight," replied Kang Ho. "Now I look at you, who shall fly so much higher than they, and I find it even more of a wonder."

"The gods have given the birds their wings, but Kang Ho has given me this celestial vessel."

"Kang Ho would be a journeyman fireworks maker in the shop of Fang Hong were it not for the genius of Chan Ji-Lin, and the gracious wisdom of the Emperor." Both men kowtowed to the north and the faraway imperial capital, then resumed their conversation.

"Come then, do inspect your living quarters," invited Kang Ho. "We have just a few things left to do and I wish your approval of the decorations."

They walked into the cabin, and Chan Ji-Lin whistled in admiration. "Such elegant tapestries!"

Kang Ho smiled. "Touch one," he suggested. Chan Ji-Lin pressed his knuckle against a detailed embroidery of the Moon over Mount Tai and was surprised when it sank in several inches. "There are five layers of goose down, so that if there are storms in the celestial seas, you will be well protected," explained Kang Ho. "The couch from which you will work the control levers has eight layers of padding and there are woven silk belts to keep you from losing your balance."

Chan Ji-Lin bowed his head, tears in

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his eyes. "My friend, I could not have done this without you," he managed to say after a moment.

"We were fated to meet," answered Kang Ho. "In a week, the dream we both dream will come true. "

The hills around the launch site of the celestial vessel were black with people, and the noise of so many thousands of spectators was distracting even at the base of the gantry. Kang Ho and Chan Ji-Lin looked over the broad plain toward the distant dais where the local mandarins and the Imperial representative sat in state.

"I can not quite believe it is the day." murmured Chan Ji-Lin softly. "My last hour before the greatest journey ever taken, to be gone for who knows how long."

"This brings up one small matter," interjected Kang Ho politely. "We have discussed much of the means of your departure, and nothing of the means of your return."

Chan Ji-Lin waved his hand vaguely. "I have thought little of it myself. I assume the people of the Moon will assist me in building another celestial vessel, for would not the Emperor of China assist an ambassador from afar in completing a journey home?"

"Assuredly," agreed Kang Ho, though his brow remained creased as though from worry.

A blast of trumpets from afar interrupted both their thoughts. "The moment the astrologers deemed auspicious draws near," exclaimed Chan Ji-Lin. He seized Kang Ho by both shoulders and embraced him. "My friend, my companion, you have made this all possible. Were it not for you, I should have ventured forth in a craft so primitive that the mandarins of the Moon would have looked down their noses in condescension. You are the finest maker of celestial vessels in all worlds, I am sure of it!"

"My friend, my patron, my heart shall be with you," declared Kang Ho. He bowed deeply, then started the long climb down the gantry to the ground. Once he got there, it was a walk of some minutes to get to the very end of the fuse, and a moment or two more to find the tinderbox that he kept up his sleeve. He bowed toward the distant dais and the Imperial flag as the giant drums rolled, and there was a vast silence as he took flint and tinder and struck the spark. The fuse sputtered, faded, and then flared up in a shower of sparks and a smell of sulfurous smoke. Kang Ho took a few steps toward the dais and safety—and then turned and ran for all he was worth to the gantry. In a few moments of frenzied climbing, he reached the top and threw himself on the floor next to the cage of carrier pigeons.

"You shall need the finest maker of celestial vessels in all the worlds to bring you back, and I am coming with you!" he announced to the shocked Chan Ji-Lin as the first rocket ignited and their whole world shook. There were a few moments of roaring, terrifying chaos as pressure like a giant hand crushed them deep into the silks and goosedown of their vessel, and then they passed out and knew no more.

Chan Ji-Lin awakened to the feel of a light breeze on his cheek, the smell of pine trees, and the alarmed squawking of the three carrier pigeons which had survived the trip. "I am alive," he wondered aloud. He heard a groan from somewhere nearby and saw a familiar figure stirring from beneath a pile of bamboo splinters and goosedown. "We are alive," he corrected himself. "We made it to the Moon!" he exulted. He tried to remember the beautiful, brief, but elegant poem that the Emperor had sent for him to read on arrival. "A man takes one small step, and all mankind takes a leap with him," he pronounced ceremoniously. He was going to continue the poem, but a rustling noise behind him made him jump. He looked around and saw a scene that sprung straight

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from his most wild dreams of poetry. Two young women came into the meadow, wearing little but wreaths of flowers and expressions of curiosity. "Tao Yuan-Ming, Li Po, all you poets, you were right," he breathed rapturously: "The maidens of the Moon are everything you said!"

The chief of the Beaver band of the People looked at the strange thing that had fallen by the edge of Lake Michigan and sighed. He had been assured by his scouts that it was not actually a bird, even though little pieces of feathers blew around it every time the spring breeze came up. It might have been a sending from the Gods, even though to his eyes it seemed to be made of some kind of splintered wood. It was a curious omen that it had landed right by the place where the young women of the tribe were finishing their womanhood rite, but the shaman said it was probably best that he knew no more of exactly what was happening there. He had enough problems as it was, what with Soaring Hawk's pestering him with his mad scheme of wanting to visit the Moon . . . ■

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HOMINIDS

Conclusion

Robert J. Sawyer

Illustration by Vincent Di Fate

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The most alien kind of world may be one that is *almost* like your own.

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The present day. ***Ponter Boddit*** *and* ***Adikor Huld*** *are male quantum-computing researchers living on a parallel version of Earth, where Neanderthals survived to the present day and our kind of* Homo sapiens *did not. While attempting to factor an enormously large number, a portal opens between their timeline and ours, and Ponter, as well as all the air in the quantum-computing chamber, is transferred here.*

Ponter and Adikor's lab had been built in a unique location: 2 kilometers beneath the surface, in their world's deepest nickel mine, where their sensitive equipment would be shielded from cosmic rays. For similar reasons, in this version of Earth a physics facility exists at the same subterranean location, in what we call Northern Ontario: the Sudbury Neutrino Observatory. SNO consists of a giant acrylic sphere filled with heavy water suspended in a six-story-tall chamber full of regular water. The arrival of all the air transferred with Ponter bursts the sphere apart.

Ponter almost drowns in the neutrino detector, but he is rescued by ***Louise Benoît****, a postdoctoral physics student from Montreal. Ponter is taken by ambulance to the hospital, accompanied by* ***Reuben Montego****, the mine-site physician. There, an astonished doctor with a degree in osteology identifies Ponter as being a Neanderthal, based on his cranial morphology—although how he could possibly have come to be here, no one yet knows.*

Meanwhile, ***Mary Vaughan****, a geneticist who specializes in recovering DNA from ancient specimens, is raped on the campus of Toronto's York University, where she works. She makes her way home and finds a message waiting from Dr. Montego: he wants her to fly up to Sudbury to authenticate a Neanderthal specimen found there "in remarkable condition." Mary, still devastated by the rape, reluctantly agrees to go.*

Ponter, like all modern Neanderthals, has a Companion implant embedded in the skin of his forearm. His is a sophisticated model with significant intelligence; it goes by the name of ***Hak****. Although Ponter is severely disoriented by what has happened to him, Hak manages to figure out where they are, and even begins to learn some English.*

Back in the Neanderthal world, in which males and females live mostly separate lives, Adikor, who was Ponter's partner in life as well as his research partner, is stunned to be charged with murder. The disappearance of Ponter has suggested foul play, at least to ***Daklar Bolbay****. Bolbay, a female, had lived with the recently deceased* ***Klast****, another female; Bolbay had been Klast's woman-mate. But Klast had also had a man-mate, a male she consorted with when Two became One, the four days out of each month during which male and female Neanderthals come together. Her man-mate had been Ponter, and she had had two daughters by him, of whom Bolbay is now legal guardian. And on their behalf, she has put forward the charge that Adikor has murdered their father.*

Despite it being "Last Five"—the final five days of a lunar month, during which female Neanderthals, all of whose menstrual cycles are synchronized, suffer from PMS, Adikor goes into the Center, the female-occupied territory. He entreats ***Jasmel Ket****, Ponter's elder daughter, to speak on his behalf at the preliminary murder trial. If the charge against him is substantiated, Adikor, and everyone who shares 50% of his genetic material, will be sterilized in order to remove the murderous genes from the Neanderthal gene pool.*

Adikor explains to ***Lurt****, his own woman-mate, why he has chosen Jasmel to speak on his behalf. Lurt, a chemist, agrees with Adikor's choice, and promises to render any assistance she can.*

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Adikor has at least an inkling of what has really happened to Ponter, and he and Jasmel head back to the nickel mine to attempt to replicate the factoring experiment, in hopes of retrieving him.

But when they arrive at the elevator that leads down to the quantum-computing lab, Adikor is confronted by an Enforcer. When Daklar's charge against Adikor was filed, Adikor was placed under "judicial scrutiny." Companion implants transmit everything they see to the central "Alibi Archives." But the 2 kilometers of rock overhead would cut off Adikor's Companion transmissions if he went down to the lab, and so the Enforcer won't allow him to do so. It seems that Adikor will have to get the judicial scrutiny lifted before he'll be able to try to retrieve his beloved Ponter.

Mary Vaughan, who had recovered DNA from the original Neanderthal fossil several years before, meets Ponter in the Sudbury hospital and takes samples of his DNA. She transports the specimens to Laurentian University in Sudbury, and, using the genetics lab there, sets about duplicating Ponter's DNA through the polymerase chain reaction (PCR).

While the duplication is occurring, Mary goes to the Laurentian University rape crisis center; after all, she has much more anonymity here than back down south in Toronto.

Hak, Ponter's Companion implant, has identified the strange humanlike creatures populating this world as Gliksins: a form of humanity long extinct on Ponter's world. Since there's nothing wrong with Ponter, Dr. Montego sneaks him past the journalists prowling around the hospital, and takes Ponter, and Louise Benoît, out to his country home. Hak is getting better at understanding English, and Louise manages to determine that Ponter is a quantum physicist.

Mary completes her study of Ponter's DNA: he really is a Neanderthal. She joins Dr. Montego and Louise for a barbecue dinner at Montego's house, but Ponter takes ill there, collapsing. Dr. Montego makes an emergency call to Health Canada's Laboratory Centre for Disease Control.

The preliminary hearing of the murder charge against Adikor begins. Daklar Bolbay outlines her case, pointing out that Adikor contrived a situation in which the transmissions from his and Ponter's Companion implants could not be received by the alibi archives. This, she says, gave Adikor, whom she believes was jealous of Ponter's greater scientific stature, the perfect opportunity to commit murder.

Daklar then shows recordings that were made of transmissions from Ponter's Companion implant 19 years previously, when Ponter and Adikor were students together at the Science Academy. During an argument, Adikor, who has a history of trouble controlling his temper but who has since been receiving treatment for that, smashes Ponter in the face with his fist—and when a Neanderthal does that, with all his strength behind it, the blow can easily be fatal. Ponter narrowly survives.

Adikor protests that this is unfair evidence to introduce: Ponter forgave Adikor and never pressed charges against him, and so, under Neanderthal law, no crime was committed. But Daklar contends that Adikor's past violence against Ponter establishes an excellent circumstantial murder case, and says the matter should be sent on to a full trial.

Mary, Dr. Montego, Louise, and Ponter are quarantined in Montego's house by order of Health Canada. After Ponter's fever breaks, Mary begins to find herself attracted to the big guy, in a general sort of way. This is actually a relief to her: she'd thought that after the rape, she'd never be able to look at a man in a sexual way again.

Mary and Dr. Montego realize that

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because Ponter doesn't come from an agricultural society, he probably didn't bring anything regular humans are susceptible to from his world; rather, he's likely suffering from something he caught since arriving on this version of Earth.

Ponter's Companion has now learned enough English to allow for meaningful conversations. Mary and Ponter talk about the differences between their two worlds. Mary is shocked to learn that Neanderthal society has absolutely no religion or belief in an afterlife. She's also surprised to learn that the Neanderthals purge their gene pool of aberrant genes.

Ponter's daughter, Jasmel Ket, presents a defense of Adikor to the preliminary hearing, and Adikor himself tries to introduce the idea that Ponter may have disappeared into a parallel world rather than having being killed. But the adjudicator rejects this seemingly outlandish notion, and Adikor is indeed handed over for a full trial.

Having honored her commitment to speak for Adikor, Jasmel now deserts him, having been appalled by the sight of Adikor almost killing her father years before. But after reviewing more of Ponter's archive recordings, she realizes that her father really did love and trust Adikor, and so she agrees to continue to help him prove his innocence.

Jasmel has now figured out why Daklar is pursuing Adikor with such vengeance, but she won't tell him the reason, saying he must hear it directly from Daklar.

Chapter 36

Reuben, Louise, Ponter, and Mary sat around the table in Reuben's kitchen. Everyone but Louise was eating hamburgers; Louise was picking at a plate of salad.

Apparently, in Ponter's world, people ate with gloved hands. Ponter didn't like using cutlery, but the hamburger seemed a good compromise. He didn't eat the bun, but instead used it to manipulate the meat, constantly squeezing the patty forward and biting off the part that protruded from the disks of bread.

"So, Ponter," said Louise, making conversation, "do you live alone? Back in your world, I mean."

Ponter shook his head. "No. I lived with Adikor."

"Adikor," repeated Mary. "I thought he was the person you worked with?"

"Yes," said Ponter. "But he is also my partner."

"Your business partner, you mean," said Mary.

"Well, that too, I suppose. But he is my *partner*; that is the word we use. We share a home."

"Ah," said Mary. "A roommate."

"Yes."

"You share household expenses and chores."

"Yes. And meals and a bed and . . ."

Mary was angry with herself for the way her heart fluttered. She knew lots of gay men; she was just used to them coming out of the closet, not popping through a transdimensional portal.

"You're gay!" said Louise. "How cool is that!"

"Actually, I was happier at home," said Ponter.

"No, no, no," said Louise. "Not happy. *Gay*. Homosexual." *Bleep*. "Having sexual relations with one's own gender: men who have sex with other men, or women who have sex with other women."

Ponter looked more confused than ever. "It is impossible to have sex with a member of the same gender. Sex is the act of potential procreation and it requires a male and a female."

"Well, all right, not sex as in sexual intercourse," said Louise. "Sex as in intimate contact, as in—you know—um, affectionate touching of . . . of the genitals."

"Oh," said Ponter. "Yes, Adikor and I did that."

"That's what we call being homosexu-

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al," supplied Reuben. "Having such contact only with members of your own gender."

"Only?" said Ponter, startled. "You mean exclusively? No, no, no. Adikor and I kept each other company when Two were separate, but when Two became One, we of course had—what did you call it, Lou?—'affectionate touching of the genitals' with our respective females . . . or, at least I did until Klast, my woman-mate, died."

"Ah," said Mary. "You're bisexual." *Bleep.* "You have genital contact with men and women."

"Yes."

"Is everyone like that in your world?" asked Louise, stabbing some lettuce with her fork. "Bisexual?"

"Just about." Ponter blinked, getting it at last. "You mean it is different here?"

"Oh, yes," said Reuben. "Well, for most people, anyway. I mean, sure, there are some bisexual people, and lots and lots of gay—homosexual—people. But the vast majority are heterosexual. That means they have affectionate contact only with members of the opposite gender."

"How boring," said Ponter.

Louise actually giggled. Then, composing herself, she said, "So, do you have any children?"

"Two daughters," said Ponter, nodding. "Jasmel and Megameg."

"Lovely names," said Louise.

Ponter looked sad, obviously thinking of the fact that he'd likely never see them again.

Reuben clearly saw this, too, and sought to move the conversation to something less personal. "So, um, so what's this 'Two become One' you mentioned? What's that all about?"

"Well, on my world, males and females live mostly apart, so—"

"Binford!" exclaimed Mary.

"No, it is true," said Ponter.

"That wasn't a swear word," said Mary. "It's a man's name. Lewis Binford is an anthropologist who argues the same thing: that Neanderthal men and women lived largely separate lives on this Earth. He bases it on sites at Combe Grenal, in France."

"He is correct," said Ponter. "Women live in the Centers of our territories; males at the Rims. But once a month, we males come into the Center and spend four days with the females; we say that 'Two become One' during this time."

"Par-tay!" said Louise, grinning.

"Fascinating," said Mary.

"It is necessary. We do not produce food the way you do, so the population size must be kept in check."

Reuben frowned. "So this 'Two becoming One' business is for birth control?"

Ponter nodded. "In part. The Gray Council—the governing body of elders—sets the dates on which we come together, and Two normally become One when the women are incapable of conceiving. But if it is time to produce a new generation, then the dates are changed, and we come together when the women are most fertile."

"Goodness," said Mary. "A whole planet on the rhythm method. The Pope would like you guys. But—but how can that work? I mean, surely your women don't all have their periods—undergo menstruation—at once?"

Ponter blinked. "Of course they do."

"But how could—oh, wait. I see." Mary smiled. "That nose of yours: it's very sensitive, isn't it?"

"I do not think of it as being so."

"But it is—compared to ours I mean. Compared to the noses we have."

"Well, your noses *are* very small," said Ponter. "They are, ah, rather disconcerting to look at. I keep thinking you will suffocate—although I have noticed many of you breathe through your mouths, presumably to avoid that."

"We've always assumed that Neanderthals evolved in response to Ice Age conditions," said Mary. "And our best guess was that your large noses allowed you to humidify frigid air before drawing it into your lungs."

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"Our—the scientists who study ancient humans—believe the same thing," said Ponter.

"The climate has warmed up a great deal, though, since your big noses evolved," said Mary. "But you've retained that feature perhaps because it has the beneficial side effect of giving you a much better sense of smell than you would have had otherwise."

"Does it?" said Ponter. "I mean, I can smell all of you, and all the different foods in the kitchen, and the flowers out back, and whatever acrid thing Reuben and Lou have been burning downstairs, but—"

"Ponter," said Reuben, quickly, "we can't smell you at all."

"Really?"

"Yes. Oh, if I stuck my nose right into your armpit, I might smell something. But normally we humans can't smell each other."

"How do you find one another in the dark?"

"By voice," said Mary.

"Very strange," said Ponter.

"But you can do more than just detect a person's presence, can't you?" said Mary. "That time you looked at me. You could . . ." She swallowed but, well, Louise was another woman, and Reuben was a doctor. "You could tell I was having my period, couldn't you?"

"Yes."

Mary nodded. "Even women of Louise and my kind, if they live together long enough in the same house, can get their menstrual cycles synchronized—and we have lousy senses of smell. I guess it makes sense that whole cities of your women would be on the same cycle."

"It never occurred to me that it might be another way," said Ponter. "I thought it odd that you were menstruating but Lou was not."

Louise frowned but said nothing.

"Look," said Reuben, "does anybody want anything else? Ponter, another Coke?"

"Yes," said Ponter. "Thank you."

Reuben got up.

"You know that stuff's got caffeine in it?" said Mary. "It's addictive."

"Do not worry," said Ponter. "I am only drinking seven or eight cans a day."

Louise laughed and went back to eating her salad.

Mary took another bite of her hamburger, circles of onion crunching beneath her teeth. "Wait a minute," she said, once she'd swallowed. "That means your females don't have hidden ovulation."

"Well, it is hidden from *view*," Ponter said.

"Yes, but . . . well, you know, I used to team-teach a course with the Women's Studies department: The Biology of Sexual Power Relationships. We'd assumed that hidden ovulation was the key to females gaining constant protection and provisioning by males. You know: if you can't tell when your female is fertile, you better be attentive all the time, lest you be cuckolded."

Hak bleeped.

"Cuckolded," repeated Mary. "That's when a man is investing his energies providing for children that aren't biologically his. But with hidden ovulation—"

Ponter's laugh split the air; his massive chest and deep mouth gave him a deep, thunderous guffaw.

Mary and Louise looked at him, astonished. "What's so funny?" said Reuben, depositing another Coke in front of Ponter.

Ponter held up a hand; he was trying to stop laughing, but wasn't succeeding yet. Tears had appeared at the corners of his sunken eyes, and his normally pale skin was looking quite red.

Mary, still seated at the table, put her hands on her hips—but immediately became self-conscious of her body language; hands on hips increased one's apparent size, in order to intimidate. But Ponter was so much stouter and better muscled than any woman—or just about any man—that it was a ridiculous thing to be doing. Still, she demanded, "Well?"

"I am sorry," said Ponter, regaining his

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control. He used his long thumb to wipe the tears from his eyes. "It is just that sometimes your people do have ridiculous ideas." He smiled. "When you talk about hidden ovulation, you mean that human females do not have genital swelling when they are in heat, right?"

Mary nodded. "Chimps and bonobos do; so do gorillas and most other primates."

"But humans did not stop having such swelling in order to hide ovulation," said Ponter. "Genital swelling disappeared when it was no longer an effective signal. It disappeared when the climate got colder and humans started wearing clothing. That sort of visual display, based on engorging tissues with fluid, is energetically expensive; there was no value in maintaining it once we were covering our bodies with animal hides. But, at least for my people, ovulation was still obvious due to smell."

"You can smell ovulation, as well as menstruation?" asked Reuben.

"The . . . chemicals . . . associated with them, yes."

"Pheromones," supplied Reuben.

Mary nodded slowly. "And so," she said, as much to Ponter as to herself, "males could go off for weeks at a time without worrying about their females being impregnated by somebody else."

"That is right," said Ponter. "But there is more to it than that."

"Yes?" said Mary.

"We say now that the reason our male ancestors—I think you have the same metaphor—'headed for the hills' was because of the, ah, unpleasantness of females during Last Five."

"Last Five?" said Louise.

"The last five days of the month; the time leading up to the beginning of their periods."

"Oh," said Reuben. "PMS. Premenstrual syndrome."

"Yes," said Ponter. "But, of course, that is not the real reason." He shrugged a little. "My daughter Jasmel is studying pregeneration-one history; she explained it to me. What really happened was that men used to fight constantly over access to women. But, as Mare has noted, the only time access to women is evolutionarily important is during the part of each month when they might become pregnant. Since all women's cycles were synchronized, men got along much better for most of the month if they retreated from females, only to return as a group when it was reproductively important that they do so. It was not female unpleasantness that led to the split; it was male violence."

Mary nodded. It had been years since she'd cotaught that course on Sexual Power Relationships, but it seemed downright typical: men causing the problem and blaming women for it. Mary doubted she'd ever meet a female from Ponter's world, but, at that moment, she felt real affinity with her Neanderthal sisters.

Chapter 37

"Healthy day, Daklar," said Jasmel, coming through the door to the house. Although Jasmel Ket and Daklar Bolbay still shared a home, they had not spoken much since the *dooslarm basadlarm*.

"Healthy day," repeated Bolbay, without warmth. "If you—" Her nostrils dilated. "You're not alone."

Adikor came through the door as well. "Healthy day," he said.

Bolbay looked at Jasmel. "More treachery, child?"

"It's not treachery," Jasmel said. "It's concern—for you, and for my father."

"What do you want of me?" said Bolbay, looking through narrowed eyes at Adikor.

"The truth," he said. "Just the truth."

"About what?"

"About *you*. About why you are pursuing me."

"I'm not the one under investigation," said Bolbay.

"No," agreed Adikor. "Not yet. But that may change."

"What are you talking about?"

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"I am prepared to have you served with documents of my own," said Adikor.

"On what basis?"

"On the basis that you are unlawfully interfering with my life."

"That's ridiculous."

"Is it?" Adikor shrugged. "We'll let an adjudicator decide that."

"It's a transparent attempt to stall the process that will lead to your sterilization," said Bolbay. "Anyone can see that."

"If it is—if it is *that* transparent, that flimsy—then an adjudicator will dismiss the matter . . . but not before I have had a chance to question you."

"Question me? About what?"

"About your motive. About why you are doing this to me."

Bolbay looked at Jasmel. "This was your idea, wasn't it?"

"It was also," said Jasmel, "my idea that we come here first, before Adikor proceeded with the accusation. This is a family matter: you, Daklar, were my mother's woman-mate, and Adikor here is my father's man-mate. You have been through a lot, Daklar—we all have—with the loss of my mother."

"This has nothing to do with Klast!" snapped Bolbay. *"Nothing."* She looked at Adikor. "It's about *him*."

"Why?" said Adikor. "Why is it about me?"

Bolbay shook her head again. "We don't have anything to talk about."

"Yes, we do," said Adikor. "And you will answer my questions here, or you will answer them in front of an adjudicator. But you *will* answer them."

"You're bluffing" said Bolbay.

Adikor raised his left arm, with his wrist facing toward her. "Is your name Daklar Bolbay, and do you reside here in Saldak Center?"

"I won't accept documents from you."

"You're just delaying the inevitable," said Adikor. "I will get a judicial server—who can upload to your implant whether you pull out the control bud or not." A pause. "I say again, Are you Daklar Bolbay, and do you reside here in Saldak Center?"

"You would really do this?" said Bolbay. "You would really drag me before an adjudicator?"

"As you have dragged me," said Adikor.

"Please," said Jasmel. "Just tell him. It's better this way—better for you."

Adikor crossed his arms in front of his chest. "Well?"

"I've nothing to say," Bolbay replied.

Jasmel let out a great, long sigh. "Ask her," she said softly when it was done, "about *her* man-mate."

"You don't know anything about that," snapped Bolbay.

"Don't I?" said Jasmel. "How did you learn that Adikor was the one who had hit my father?"

Bolbay said nothing.

"Obviously, Klast told you," said Jasmel.

"Klast was my woman-mate," said Bolbay, defiantly. "She didn't keep secrets from me."

"And she was my mother," said Jasmel. "Neither did she keep them from me."

"But . . . she . . . I . . ." Bolbay trailed off.

"Tell me about your man-mate," said Adikor. "I—I don't think I've ever met him, have I?"

Bolbay shook her head slowly. "No. He's been gone for a long time; we separated long ago."

"And that's why you don't have children of your own?" asked Adikor, gently.

"You're so *smug*," replied Bolbay. "You think it's that simple? I couldn't keep a mate, and so I never reproduced? Is *that* what you think?"

"I don't think anything," said Adikor.

"I would have been a good mother," said Bolbay, perhaps as much to herself as to Adikor. "Ask Jasmel. Ask Megameg. Since Klast died, I've looked after them *wonderfully*. Isn't that so, Jasmel? Isn't

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that so?"

Jasmel nodded. "But you're a 145, just like Ponter and Klast. Just like Adikor. You might still be able to have a child of your own. The dates for Two becoming One will be shifted again next year; you could . . ."

Adikor's eyebrow rolled up. "It would be your last chance, wouldn't it? You'll be 520 months old—40 years—next year, just like me. You might have a child then, as part of generation 149, but certainly not ten years later, when generation 150 will be born."

There was a sneer in Bolbay's voice. "Did you need your fancy quantum computer to figure that out?"

"And Ponter," said Adikor, nodding slowly, "Ponter was without a woman-mate. You and he had loved the same woman, after all, and you were already *tabant* for his two children, so you thought . . ."

"You and my father?" said Jasmel. She didn't sound shocked by the notion, merely surprised.

"And why not?" said Bolbay, defiantly. "I'd known him almost as long as you had, Adikor, and he and I had always gotten along."

"But now he's gone, too," said Adikor. "That *was* my first thought, you know: that you were simply inconsolable over the loss of him, and so were snapping teeth at me. But you must see, Daklar, that you're wrong to be doing that. I loved Ponter, and certainly wouldn't have interfered with his choice of a new woman-mate, so—"

"That has *nothing* to do with it," said Bolbay, shaking her head. "Nothing."

"Then why do you hate me so?"

"I don't hate you because of what happened to Ponter," she said.

"But you *do* hate me."

Bolbay was silent. Jasmel was looking at the floor.

"Why?" said Adikor. "I've never done anything to you."

"But you hit Ponter," snapped Bolbay.

"Ages ago. And he forgave me."

"And so you got to stay whole," she said. "You got to have a child of your own. You *got away* with it."

"With what?"

"With your crime! With trying to kill Ponter!"

"I *wasn't* trying to kill him."

"You were violent, a monster. You *should* have been sterilized. But my Pelbon . . ."

"Who is Pelbon?" said Adikor.

Bolbay fell silent again.

"Her man-mate," said Jasmel, softly.

"What happened to Pelbon?" asked Adikor.

"You don't know what it's like," said Bolbay, looking away. "You have no idea. You wake up one morning to find two enforcers waiting for you, and they take your man-mate away, and—"

"And what?" said Adikor.

"And they castrate him," said Bolbay.

"Why?" asked Adikor. "What did he do?"

"He didn't do *anything*," said Bolbay. "He didn't do a single thing."

"Then why . . ." started Adikor. But then it hit him. "Oh. One of his relatives . . ."

Bolbay nodded but didn't meet Adikor's eyes. "His brother had assaulted someone, and so his brother was ordered sterilized along with—"

"Along with everyone who shared 50 percent of his genetic material," finished Adikor.

"He didn't do *anything*, my Pelbon," said Bolbay. "He didn't do anything to anyone, and he was punished. *I* was punished. But you! You almost killed a man, and you got away with it! They should have castrated you, not my poor Pelbon!"

"Daklar," said Adikor. "I'm sorry. I'm so sorry . . ."

"Get out," said Bolbay firmly. "Just leave me alone."

"I—"

"Get out!"

Chapter 38

Ponter finished his hamburger, then looked at Louise, Reuben, and Mary in

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turn. "I do not wish to complain," he said, "but I am getting tired of this—this *cow*, do you call it? Is there a chance we might ask the people outside to bring us something else for tonight?"

"Like what?" asked Reuben.

"Oh, anything," said Ponter. "Maybe some mammoth steaks."

"What?" said Reuben.

"Mammoth?" said Mary, stunned.

"Is Hak incorrectly rendering what I am saying?" asked Ponter. "Mammoth. You know—a hairy elephant of northern climes."

"Yes, yes, yes," said Mary. "We *know* what a mammoth is, but . . ."

"But what?" asked Ponter, eyebrow lifted.

"But, well, I mean . . . mammoths are extinct," said Mary.

"Extinct?" repeated Ponter, surprised. "Come to think of it, I have not seen any here, but, well, I assumed they did not like coming close to this massive city."

"No, no, they're extinct," said Louise. "All over the world. They've been extinct for thousands of years."

"Why?" asked Ponter. "Was it illness?"

Everyone fell silent. Mary slowly exhaled the air in her lungs, trying to decide how to present this. "No, that's not why," she said, at last. "Umm, you see, we—our kind, our ancestors—we hunted mammoths to extinction."

Ponter's eyes went wide. "You did what?"

Mary felt nauseous; she hated having her version of humanity come up so short. "We killed them for food, and, well, we kept on killing them until there were none left."

"Oh," said Ponter, softly. He looked out the window, at the large backyard to Reuben's house. "I am fond of mammoths," he said. "Not just their meat—which is delicious—but as animals, as part of the landscape. There is a small herd of them that lives near my home. I enjoy seeing them."

"We have their skeletons," said Mary, "and their tusks, and every once in a while a frozen one is found in Siberia, but . . ."

"All of them," said Ponter, shaking his head back and forth slowly, sadly. "You killed all of them . . ."

Mary felt like protesting, "Not me personally," but that would be disingenuous; the blood of the mammoths was indeed on her house. Still, she needed to make some defense, feeble though it was: "It happened a long time ago."

Ponter looked queasy. "I am almost afraid to ask," said Ponter, "but there are other large animals I am used to seeing in this part of the world on my version of Earth. Again, I had assumed they were just avoiding this city of yours, but . . ."

Reuben shook his shaven head. "No, that's not it."

Mary closed her eyes briefly. "I'm sorry, Ponter. We wiped out just about all the megafauna—here, and in Europe . . . and in Australia"—she felt a knot in her stomach as the litany grew—"and in New Zealand, and in South America. The only continent that has many really big animals left is Africa, and most of those are endangered."

Bleep.

"On the verge of extinction," said Louise.

Ponter's tone was one of betrayal. "But you said this had all happened long ago."

Mary looked down at her empty plate. "We stopped killing mammoths long ago, because, well, we ran out of mammoths to kill. And we stopped killing Irish elk, and the big cats that used to populate North America, and woolly rhinoceroses, and all the others, because there were none left to kill."

"To kill every member of a species . . ." said Ponter. He shook his massive head slowly back and forth.

"We've learned better," Mary said. "We now have programs to protect endangered species, and we've had some real successes. The whooping crane was once almost gone; so was the bald eagle. And the buffalo. They've all come back."

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Ponter's voice was cold. "Because you stopped hunting them to extremes."

Mary thought about protesting that it wasn't all the result of hunting; much of it had to do with the destruction by humans of the natural habitats of these creatures—but somehow that didn't seem any better.

"What . . . what other species are still endangered?" asked Ponter.

Mary shrugged a little. "Lots of kinds of birds. Giant tortoises. Panda bears. Sperm whales. Chim . . ."

"Chim?" said Ponter. "What are—?" He tilted his head, perhaps listening to Hak providing its best guess at the word Mary had started to say. "Oh, no. No. *Chimpanzees?* But . . . but these are our *cousins*. You hunt our cousins?"

Mary felt all of two feet tall. How could she tell him that chimps were killed for food, that gorillas were murdered so their hands could be made into exotic ashtrays?

"They are *invaluable*," continued Ponter. "Surely you, as a geneticist, must know that. They are the only close living relatives we have; we can learn much about ourselves by studying them in the wild, by examining their DNA."

"I know," said Mary, softly. "I know."

Ponter looked at Reuben, then at Louise, and then at Mary, sizing them up, it seemed, as if he were seeing them—*really* seeing them—for the first time.

"You kill with abandon," he said. "You kill entire species. You even kill other primates." He paused and looked from face to face again, as if giving them a chance to forestall what he was about to say, to come up with a logical explanation, a mitigating factor. But Mary said nothing, and neither did the other two, and so Ponter went on. "And, on this world, my kind is extinct."

"Yes," said Mary, very softly. She knew what had happened. Although not every paleoanthropologist agreed, many shared her view that between 40,000 and 27,000 years ago, *Homo sapiens*—anatomically modern humans—completed the first of what would be many deliberate or inadvertent genocides, wiping the planet free of the only other extant member of the same genus, a separate, more gentle species that perhaps had been better entitled to the double meaning of the word humanity.

"Did you kill us?" asked Ponter.

"That's a much-debated question," said Mary. "Not everyone agrees on the answer."

"What do *you* think happened?" asked Ponter, golden eyes locked on Mary's own.

Mary took a deep breath. "I—yes, yes, that's what I think happened."

"You wiped us out," said Ponter, his own tone, and Hak's rendition of it, clearly being controlled with difficulty.

Mary nodded. "I'm sorry," she said. "Really, I am. It happened long ago. We were savages then. We—"

Just then, the phone rang. Reuben, looking relieved at the interruption, jumped up from the table and lifted a handset. "Hello?" he said

Mary looked up as Reuben's voice became more excited. "But that's terrific!" continued the doctor. "That's wonderful! Yes, no—yes, yes, that's fine. Thank you! Right. Bye."

"Well?" said Louise.

Reuben was clearly suppressing a grin. "Ponter has distemper," he said, replacing the phone's handset.

"Distemper?" repeated Mary. "But humans don't get distemper."

"That's right," said Reuben. "We're naturally immune. But Ponter isn't, because his kind hasn't lived with our domesticated animals for generations. To be precise, he's got the horse version of distemper; vets call it *strangles* when it happens to a young horse. It's caused by a bacterium, *Streptococcus equii*. Fortunately, penicillin is the usual treatment given to horses, and that's one of the antibiotics I've been giving Ponter. He should be fine."

"So we don't have to worry about get-

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ting sick?" asked Louise.

"Not only that," said Reuben, smiling broadly now, "but they're lifting the quarantine! Assuming the final set of cultures—due later tonight—come back negative, we can leave here tomorrow morning!"

Louise clapped her hands together. Mary was delighted, too. She looked over at Ponter, but he had his head bowed, presumably still thinking about the extinction of his kind on this world.

Mary reached over and touched his arm. "Hey, Ponter," she said gently. "Isn't that great news? Tomorrow, you'll get to go out and see our world!"

Ponter lifted his head slowly and looked at Mary. She was still learning to read the subtleties of his expressions, but the words, "Do I have to?" seemed to fit with his widened eyes and slightly open mouth.

But finally he just nodded, as if in resignation.

Chapter 39

Ponter spent most of the evening alone, just staring out the kitchen window at Reuben's large backyard, a sad look on his large face.

Louise and Mary were both sitting in the living room. Mary was sorry she'd left her current book down in Toronto. She'd been in the middle of Scott Turow's latest and really wanted to get back to it, but had to content herself with leafing through the latest *Time*. President Bush was on the cover this week; Mary thought it possible that Ponter might be on the cover of the next issue. She preferred *The Economist* herself, but Reuben didn't subscribe to it. Still, Mary did always enjoy Richard Corliss's film reviews, even if she had no one to go to the movies with these days.

Louise, in the adjacent armchair, was writing a letter—in French, Mary had noted—in longhand on a yellow pad. Louise wore track shorts and an INXS T-shirt, her long legs tucked sideways beneath her body.

Reuben came into the room and crouched down between the two women, addressing them both in hushed tones. "I'm concerned about our boy Ponter," he said.

Louise sat down her yellow pad. Mary closed her magazine. "Me, too," said Mary. "He didn't seem to take that news about the extinction of his kind very well."

"No, he didn't," said Reuben. "And he's been under a lot of stress, which is just going to get worse tomorrow. The media will be all over him, not to mention government officials, religious kooks, and more."

Louise nodded. "I suppose that's true."

"What can we do about it?" asked Mary.

Reuben frowned for a time, as if thinking about how to express something. Finally, he said, "There aren't many people of my color here in Sudbury. Things are better down in Toronto, I'm told, but even there, black men get hassled by the police from time to time. 'What are you doing here?' 'Is this your car?' 'Can we see some ID?'" Reuben shook his head. "You learn something going through that. You learn you've got rights. Ponter isn't a criminal, and he isn't a threat to anyone. He's not at a border station, so no one can legally demand that he prove he should be allowed to be in Canada. The government may *want* to control him, the police may *want* to keep him under surveillance—but that doesn't matter. Ponter's got rights."

"I certainly agree with that," said Mary.

"Either of you ever been to Japan?" asked Reuben.

Mary shook her head. So did Louise.

"It's a wonderful country, but there're almost no non-Japanese there," said Reuben. "You can go all day without seeing a white face, let alone a black one—I saw precisely two other blacks during the entire week I was there. But I remember walking through downtown

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Tokyo one day: I must have passed ten thousand people that morning, and they were all Japanese. Then, as I'm walking along, I see this white guy coming toward me. And he smiles at me—he doesn't know me from Adam, but he sees that I'm a fellow Westerner. And he gives me this smile, like to say I'm so glad to see a brother—a brother! And I suddenly realize that I'm smiling at him, too, and thinking the same thing. I've never forgotten that moment." He looked at Louise, then at Mary. "Well, old Ponter can search all he wants, all over the world, and he's not going to see a single face that he recognizes as being like him. That white guy and I—and all those Japanese and me—we have much more in common than Ponter does with any of the six billion people on this globe."

Mary glanced into the kitchen at Ponter, who was still staring out the window, a balled hand under the middle of his long jaw, propping it up. "What can we do about it?" she asked.

"He's been almost a prisoner since he arrived," said Reuben, "first in the hospital, then here, quarantined. I'm sure he needs time to think, to get some mental equilibrium." He paused. "Gillian Ricci tipped me off in an email. Apparently the same thought I had earlier has now occurred to the brass—or should I say the nickel?—at Inco. They want to question Ponter at length about any other mining sites in his world that he might know about. I'm sure he'll be glad to help, but he still needs more time to adjust."

"I agree," said Mary. "But how can we make sure he gets it?"

"They're lifting the quarantine tomorrow morning, right?" said Reuben. "Well, Gillian says I can hold another press conference here at 10:00 a.m. Of course, the media will be expecting Ponter to be there—so I think we should get him out before then."

"How?" asked Louise. "The RCMP has the place surrounded—supposedly to keep us safe from people who might try to break in, but probably just as much to keep an eye on Ponter."

Reuben nodded. "One of us should take him away, out into the country. I'm his doctor; that's what I prescribe. Rest and relaxation. And that's what I'll tell anyone who asks—that he's on a medical rest leave, ordered by me. We can probably only get away with that for a day or so before suits from Ottawa descend on us, but I really do think Ponter needs it."

"I'll do it," said Mary, surprising herself. "I'll take him away."

Reuben looked at Louise to see if she wanted to stake a claim herself, but she simply nodded.

"If we tell the media that the press conference will be at ten, they'll start showing up at nine," said Reuben. "But if you and Ponter head out, through my backyard, at, say, eight, you'll beat them all. There's a fence at the back, behind all those trees, but you should have no trouble hopping it. Just make sure no one sees you go."

"And then what?" said Mary. "We just go walkabout?"

"You'll need a car," said Louise.

"Well, mine's back at the Creighton Mine," said Mary. "But I can't take yours or Reuben's. The cops will surely stop us if we try to drive off. As Reuben said, we've got to sneak away."

"No problem," said Louise. "I can have a friend meet you tomorrow morning on whatever country road is behind Reuben's place here. He can drive you to the mine, and you can pick up your car there."

Mary blinked. "Really?"

Louise shrugged a little. "Sure."

"I—I don't know this area at all," said Mary. "We'll need some maps."

"Oooh!" said Louise. "I know exactly who to call, then—Garth. He's got one of those Handspring Visor thingies with a GPS module. It'll give you directions to any place, and keep you from getting lost."

"And he'd loan that to me?" said Mary, incredulous. "Aren't those things expen-

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sive?"

"Well—it'd really be me he'd be doing the favor for," said Louise. "Here, let me call him and set everything up." She rose to her feet and headed upstairs. Mary watched her go, fascinated and stunned. She wondered what it was like to be so beautiful that you could ask men to do just about anything and know that they'd almost certainly say yes.

Ponter, she realized, wasn't the only one feeling out of place.

Jasmel and Adikor took a public car back out to the Rim, back to the house Adikor had shared with Ponter. They didn't say much to each other on the trip back, partly, of course, because Adikor was lost in thought about Daklar Bolbay's revelation, and partly because neither he nor Jasmel liked the idea that someone at the alibi archive pavilion was monitoring every word they said and everything they did.

Still, they had a vexing problem. Adikor *had* to get back down to his subterranean lab; whatever minuscule chance there was that Ponter might be rescued—or, thought Adikor, although he hadn't shared this thought with Jasmel, that at least his drowned body might be recovered, exonerating Adikor—depended on him getting down there. But how to do that? He looked at his Companion, on the inside of his left wrist. He could gouge it out, he supposed—being careful not to clip his radial artery as he did so. But not only did the Companion rely on Adikor's own body for its power, it also transmitted his vital signs—and it wouldn't be able to do that if it were separated from him. Nor could he do a quick transplant onto Jasmel or somebody else; the implant was keyed to Adikor's particular biometrics.

The public car let them off at the house, and Adikor and Jasmel went inside. Jasmel wandered into the kitchen to find Pabo something to eat, and Adikor sat down, staring across the room at the empty chair that had been Ponter's favorite spot for reading.

Getting around the judicial scrutiny was a problem—a problem, Adikor realized, in science. There *must* be a way to circumvent it, a way to fool his Companion—and whoever was monitoring its output.

Adikor knew the life story of Lonwis Trob, the creator of the Companion technology; he'd studied his many inventions at the Academy. But that had been long ago, and he remembered few details. Of course, he could simply *ask* his Companion for the facts he needed; it would access the required information and display it on its little screen or any wall monitor or datapad Adikor selected. But such a request would doubtless catch the attention of the person watching over him.

Adikor felt himself becoming angry, muscles tensing, heart rate increasing, breathing growing deeper. He thought about trying to mask it, but no—he'd let the person who was watching him know how upset they were making him.

As clever as Lonwis Trob had been, there had to be a way to accomplish what he wanted—what he *needed*—to do. And what precisely was that? Define your problem exactly; that was what they'd taught him all those months ago at the Academy. Precisely what needs to be done?

No, he didn't have to defeat the Companions—which was a good thing, because he hadn't come up with a single workable idea for doing so. Indeed, it wasn't *all* the Companions he needed to disable—in fact, to do so would be unconscionable; the implants ensured the safety of everyone. He only needed to disable his own Companion, but . . .

But no, that wasn't right, either. Disabling it would do no good; Gaskdol Dut and the other enforcers might not be able to track him if the Companion stopped working, but they'd immediately know by its lack of transmissions that something was afoot. And it wouldn't take a Lonwis to figure out that Adikor

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would be heading for the mine, since he'd already been thwarted once before in trying to go there.

No, no, the real problem wasn't that his Companion was working. Rather, it was that someone was *watching* the transmissions from his Companion. That's what needed to stop—and not just for a moment or two, but for several daytenths, and—

And suddenly it came to him: the perfect answer.

But he couldn't arrange it himself; it would only work if the enforcers had no idea that Adikor was involved. Jasmel could perhaps take care of doing it, though; Adikor had to believe that it really was only his Companion being monitored. Anything beyond that would be outrageous. But how to communicate privately to Jasmel?

He rose and headed into the kitchen. "Come on, Jasmel," he said. "Let's take Pabo for a walk."

Jasmel's expression conveyed that this should be the least of their priorities just now, but she got up and went with Adikor to the back door. Pabo needed no prodding to join them; she bounded after Jasmel.

They walked out onto the deck, out into the summer heat, cicadas making their shrill whine. The humidity was high. Adikor stepped off the deck, and Jasmel followed. Pabo ran ahead, barking loudly. After a few hundred paces, they came to the brook that ran behind the house. The sound of fast-running water drowned out the insect noises. There was a large boulder—one of countless glacial erratics that dotted the landscape—in the middle of the brook. Adikor stepped on smaller rocks to get over to it, and motioned for Jasmel to follow, which she did. Pabo was now running up the riverbank.

When Jasmel reached the boulder, Adikor patted the mossy spot next to where he was sitting, indicating that she should join him. She did so, and he leaned toward her and started whispering, his words all but inaudible against the water crashing around the boulder. There was no way, he felt sure, that the Companion could pick up what he was saying. And, as he told Jasmel his plan, he saw a mischievous grin grow on her face.

Ponter sat on the couch in Reuben's office. Everyone else had gone to bed—although Reuben and Louise, next door, clearly weren't sleeping.

Ponter was sad. The sounds and smells they were making reminded him of himself and Klast, of Two becoming One, of everything he'd lost before coming to this Earth, and all the rest of it he'd lost since.

He'd had the TV on, watching a channel devoted to this thing called *religion*. There seemed to be many variations, but all of them proposed a *God*—that outlandish notion again—and a Universe that was of a finite, and often ridiculously young, age, plus some sort of after-death existence for the . . . there was no Neanderthal word for it, but "soul" had been the term Mary had used. It turned out the symbol Mary wore around her neck was a sign of the particular religion she subscribed to, and the fabric that had been wrapped around Dr. Singh's head was a sign of his somewhat different religion.

Ponter had turned the sound on the TV way down—it had been simple enough to find the appropriate control, although he doubted anything he might do would disturb the couple in the adjacent room.

"How are you feeling?" asked Klast's voice, and Ponter felt his heart leaping.

Klast!

Darling Klast, contacting him from . . .

From an *afterlife!*

But no.

No, of course it wasn't.

It was just Hak talking to him. Ponter was presumably stuck now with Hak speaking forevermore with Klast's voice, if he wanted anything other than that

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droning default male persona the device had come preprogrammed with; certainly there was no way to access the equipment needed to reprogram the implant.

Ponter let out a long sigh, then answered Hak's question. "I'm sad."

"But are you adjusting? You were quite shaky when we first got here."

Ponter shrugged a bit. "I don't know. I'm still confused and disoriented, but . . ."

Ponter could almost imagine Hak nodding sympathetically somewhere. "It will take time," said the Companion, still in Klast's voice.

"I know," said Ponter. "I know. But I *have* to get used to it, don't I? It looks like I—like *we*—are going to spend the rest of our lives here, doesn't it?"

"I'm afraid so," said Hak gently.

Ponter was quiet for a while, and Hak let him be so. Finally, Ponter said, "I guess I'd better face facts. I better start planning for a life here."

Chapter 40

DAY SEVEN
Thursday, August 8
148/119/01

NEWS SEARCH
Keyword(s): *Neanderthal*

Opposition MP Marissa Crothers charged today in the House of Commons that the clearly fake Neanderthal was a flimsy attempt by the governing Liberal party to cover up the abject failure of the 73-million-dollar Sudbury Neutrino Observatory project . . .

"Stop hogging the caveman!" That was the sentiment on a placard worn by one American protester during a large demonstration outside the Canadian embassy in Washington today. "Share Ponter with the World!" said another . . .

Invitations sent to Ponter Boddit for all-expense-paid visits received c/o the *Sudbury Star*: Disneyland; the Anchor Bar and Grill, home of the original chicken wing, in Buffalo, New York; Buckingham Palace; the Kennedy Space Center; Science North; the UFO museum in Roswell, New Mexico; Toronto's Zanzibar Tavern strip club; Microsoft headquarters; next year's World Science Fiction Convention; The Neanderthal Museum in Mettmann, Germany; Yankee Stadium. Also submitted: offers of meetings with the US, French, and Mexican presidents; the Japanese prime minister and royal family; the Pope; the Dalai Lama; Nelson Mandela; Stephen Hawking; and Anna Nicole Smith.

Question: How many Neanderthals does it take to change a light bulb? Answer: All of them.

. . . and so this columnist urges that the Creighton Mine be filled in, to prevent an army of Neanderthals invading our world via the gateway in its bowels. The last time our kind did battle with them, we won. This time, the outcome could be quite different . . .

Preliminary call for papers: Memetics and the epistemological disjuncture between *H. Neanderthalensis* and *H. Sapiens* . . .

A spokeswoman for the Centers for Disease Control and Prevention in Atlanta, Georgia, today praised the Canadian government's rapid response to the arrival of a potential plague vector. "We think they acted properly," said Dr. Ramona Keitel. "However, we've found no pathogens in the specimens they've sent us for analysis . . ."

Everything came off flawlessly. Ponter and Mary left Reuben's at just after 8:00 A.M., making it through the trees at the back of his property and over the fence without being seen; Ponter's sense of smell helped them avoid the RCMP officer patrolling the back area on foot.

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Louise's friend was indeed waiting for them. Garth turned out to be a handsome, well-muscled Native Canadian about twenty-five years old. He was extremely polite, calling Mary—to her chagrin—"ma'am," and Ponter "sir." He drove them the short distance to the Creighton Mine. The security guards recognized Mary—and Ponter, too, of course—and let them in. There, Mary and Ponter switched into her rented red Neon, which had acquired a patina of dust and bird droppings while sitting in the parking lot.

Mary knew where to head. The night before, she had said to Ponter, "Is there anywhere in particular you'd like to go tomorrow?"

Ponter had nodded. "Home," he'd said. "Take me home."

Mary had felt so very sad for him. "Ponter, I would if I could, but there's no way. You know that; we don't have the technology."

"No, no," Ponter had said. "I don't mean my home in my world. I mean my home in *this* world: the place on this version of Earth that corresponds to where my house is."

Mary had blinked. She'd never even thought of doing that. "Um, yeah. Sure. If you'd like to see it. But how will we find it? I mean, what landmarks will you recognize?"

"If you can show me a detailed map of this area, I can find the spot, and then we can go there."

Reuben's password had gotten them into a private Inco website containing detailed geological maps of the entire Sudbury basin. Ponter had no trouble recognizing the contours of the land and finding the spot he wanted, about twenty kilometers from Reuben's house.

Then Mary drove Ponter as close as she could get to the place he'd indicated. Most of the land surrounding the city of Sudbury was covered with Canadian Shield outcrops, forest, and low brush. It took them hours to hike through it all, and, although Mary wasn't much of an athlete—she played an occasional mediocre game of tennis—she actually enjoyed the exercise, at least for a while, after having been cooped up for so long at Reuben's place.

Finally, they came over a ridge, and Ponter let out a delighted yelp. "There!" he said. "Right there! That is where my house was—I mean, where my house *is*."

Mary looked around, taking in the location: on one side, there were large aspens mixed in with thin birch trees, covered with papery white bark; on the other, a lake. Mallard ducks were floating on the lake, and a black squirrel scampered across the ground. Running into the lake was a babbling brook.

"It's beautiful," said Mary.

"Yes," said Ponter, excitedly. "Of course, the vegetation is completely different on my Earth. I mean, the plants are mostly of the same types, but the specific places where they are growing are not the same. But the rock outcrops are very similar—and that boulder in the brook! How I know that boulder! I have often sat atop it reading."

Ponter had run a short distance away from Mary. "Here—right here!—is where our back door is. And over here—this is our eating room." He ran some more. "And the bedroom is right here, right beneath my feet." He made a sweeping motion with his arm. "That is the view we have from the bedroom."

Mary followed his gaze. "And you can see mammoths out there in your world?"

"Oh, yes. And deer. And elk."

Mary was wearing a loose-fitting top and lightweight slacks. "Didn't the mammoths overheat in the summer, what with all that fur?"

"They shed most of their fur in summer," Ponter said, coming over to stand nearer to her. He closed his eyes. "The sounds," he said wistfully. "The rustle of the leaves, the buzz of insects, the brook, and—there!—you hear it? The call of a loon." He shook his head slight-

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ly in wonder. "It sounds the same." He opened his eyes, and Mary could see that his golden irises were surrounded now by pink. "So close," he said, his voice trembling a bit. "So very close. If only I could—" He shut his eyes again, hard, and his whole body jerked slightly, as if he were trying by an effort of will to cross the timelines.

Mary felt her heart breaking. It must be awful, she thought, to be torn from your own world and dumped somewhere else—somewhere so similar, yet so alien. She lifted her hand, not quite sure what she intended to do. He turned to her, and she couldn't say, she didn't know, she wasn't sure which of them had moved first toward the other, but suddenly she had her arms wrapped around his broad torso, and his head was resting against her shoulder, and his body was shuddering up and down, and he cried and cried and cried, while Mary stroked his long, blond hair.

Mary tried to remember the last time she'd seen a man cry. It had been Colm, she supposed—not over any of the problems with their marriage; no, those had been borne in stony silence. But when Colm's mother had died. Even then, he'd tried to put on a brave face, letting only a few tears trickle out. But Ponter was crying now without shame, crying for the world he'd lost, the lover he'd lost, the children he'd lost, and Mary let him cry until he was good and ready to stop.

When he did, he looked up at her, and opened his mouth. She'd expected Hak to translate his words as, "I am sorry"—isn't that what a man is supposed to say after crying, after letting his guard down, after wallowing in emotion? But no, that's not what came forth. Ponter simply said, "Thank you." Mary smiled warmly at him, and he smiled back.

Jasmel Ket started her day by heading off to find Lurt, Adikor's woman.

Not surprisingly, Lurt was in her chemistry lab, hard at work. "Healthy day," said Jasmel, coming through the square door.

"Jasmel? What are you doing here?"

"Adikor asked me to come by."

"Is he all right?"

"Oh, yes. He's fine. But he needs a favor."

"For him, anything," said Lurt.

Jasmel smiled. "I was hoping you would say that."

It had taken longer to hike from Mary's car to the location of Ponter's home than Mary had expected, and, of course, just as long to hike back. By the time they did reach her car, it was after 7:00 P.M.

They were both quite hungry after all that walking, and, as they drove along, Mary suggested they get something to eat. When they came to a little country inn, with a sign advertising that it served venison, Mary pulled over. "How does this look?" she asked.

"I am no adjudicator of such things," said Ponter. "What kind of food do they provide?"

"Venison."

Bleep. "What is that?"

"Deer."

"Deer!" exclaimed Ponter. "Yes, deer would be wonderful!"

"I've never had venison myself," Mary said.

"You will enjoy it," said Ponter.

The inn's dining room only had six tables, and no one else was eating just now. Mary and Ponter sat opposite each other, a white candle burning between them. The main course took almost an hour to arrive, but she, at least, enjoyed some buttered pumpernickel bread beforehand. Mary had wanted an appetizer Caesar salad, but she felt self-conscious enough about having garlic breath when eating with regular humans; she certainly didn't want to risk it with Ponter. Instead, she had the house salad, with a sun-dried-tomato vinaigrette. Ponter also had a house salad, and although he left behind the croutons, he seemed to en-

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joy everything else.

Mary had also ordered a glass of the house red, which turned out to be eminently potable. "May I try that?" Ponter asked when it arrived.

Mary was surprised. He'd declined when offered some of Louise's wine at dinner back at Reuben's house. "Sure," said Mary.

She handed him the glass, and he took a small sip, then winced. "It has a sharp flavor," he said.

Mary nodded. "You get to like it," she said.

Ponter handed the glass back to her. "Perhaps one would," he said. Mary slowly finished the wine, enjoying the rustic, charming inn—and the company of this gentle man.

The balding innkeeper obviously knew who Ponter was; his appearance, after all, was striking, and Ponter was speaking softly in his own language, so that Hak could translate his words. Finally, it clearly got to be too much for the man. "I'm sorry," he said, coming to their table, "but Mr. Ponter, could I have your autograph?"

Mary heard Hak bleep, and Ponter raised his eyebrow. "Autograph," said Mary. "That's your own name, written out. People collect such things from celebrities." Another bleep. "Celebrities," repeated Mary. "Famous people. That's what you are."

Ponter looked at the man, astonished. "I—I would be honored," he said at last.

The man handed Ponter a pen, then flipped over the little pad he used for taking orders, exposing its white cardboard back. He placed it on the table in front of Ponter.

"You usually write a few words in addition to your name," said Mary. "'Best wishes,' or something like that."

The innkeeper nodded. "Yes, please."

Ponter shrugged, clearly stunned by it all, and then made a series of symbols in his own language. He handed the pad and the pen back to the man, who scurried away, delighted.

"You've made his day," Mary said after he disappeared.

"Made his day?" repeated Ponter, not getting the idiom.

"I mean, he will always remember today because of you."

"Ah," said Ponter, smiling at her over the candle. "And I will always remember this day because of you."

Chapter 41

Assuming Lurt could pull it off, Adikor would have access to the quantum-computing lab tomorrow. But he needed to make some arrangements before then.

Saldak was a big town, but Adikor knew most of the scientists and engineers on its Rim, and a good fraction of those who lived in the Center. In particular, he'd become friends with one of the engineers who maintained the mining robots. Dern Kord was a fat and jolly man—there were those who said he let robots do too much of his work. But a robot was just what this job called for. Adikor set out to see Dern; now that it was evening, Dern should be home from work.

Dern's house was large and rambling; the tree that formed the bulk of its shape must have been a thousand months old, dating to the very beginnings of modern arboriculture.

"Healthy—well, healthy evening," said Adikor as he came up to Dern's home. Dern was seated out on his deck, reading something on an illuminated datapad. A thin mesh between the deck's floor and the awning above it kept out insects.

"Adikor!" said Dern. "Come in, come in—watch the flap there; don't let the bugs follow. Will you have drink? Some meat?"

Adikor shook his head. "No, thank you."

"So, what brings you here?" asked Dern.

"How are your eyes?" asked Adikor. "Your vision?"

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Dern flared his nostrils at the odd question. "Fine. I've got lenses, of course, but I don't need them for reading—at least not on this pad; I just choose larger symbols."

"Go get your lenses," said Adikor. "I have something I want to show you."

Dern looked puzzled, but headed into the house. A moment later, he emerged with a pair of lenses connected to a wide elasticized fabric band. He slipped the band over his head, bringing it down to nestle in the furrow behind his browridge. The lenses were on little hinges; he flipped them down over his eyes and looked at Adikor expectantly.

Adikor reached into the pouch attached to the left hip of his pant and pulled out the sheet of thin plastic he'd written on this afternoon. Adikor had made the symbols as small as he possibly could—he'd had to search for a stylus with a fine-enough point. Scanner resolution had improved since those images of Adikor hitting Ponter had been recorded, but there still was a limit to how much detail could be made out. Adikor had endured cramps in his right hand making ideograms smaller than anyone back at the archive building could possibly read.

"What's this?" said Dern, taking the sheet and peering at it. "Oh!" he exclaimed as he began reading. "Really! Do you think? Well, well . . . I can't let you have a new one, of course—not if there's a good chance you're going to lose it. But I've got several old ones that are due to be decommissioned; one of those should fit the bill."

Adikor nodded. "Thank you."

"Now, where and when do you need this?"

Adikor was about to shush him, but for all his exuberance, Dern was no idiot. He nodded after finding the information he was looking for on the sheet. "Yes, that's fine. I'll be there, waiting for you."

After dinner, Ponter and Mary got into Mary's car and started driving back toward Sudbury. "I enjoyed today," said Ponter. "I enjoyed getting out of the city. But I suppose I should now see other places."

Mary smiled. "There's a whole wide world out there waiting to meet you."

"I understand," said Ponter. "And I must accept my new life as . . . a curiosity."

Mary opened her mouth to protest, but couldn't think of anything to say. Ponter *was* a curiosity; in a crueler century, he'd have ended up as a circus freak. Finally, she just let the comment pass, and said, "Our world has a lot of variety. I mean, geographically it's no more varied than yours, I'm sure, but we have many cultures, many kinds of architecture, many ancient buildings."

"I understand that I must travel; that I must contribute," said Ponter. "I had thought to stay here, to stay near Sudbury, in case, somehow, the portal reopened, but it has been so many days now. I am sure Adikor has tried; he must, therefore, have failed—the conditions must not be reproducible." Mary could hear reluctant acceptance growing behind his words. "Yes, I will go wherever I am expected to go; I will go far from here."

By then they were well away from the lights of the inn and the small village it had been part of. Mary looked out her side window, noticing the sky.

"My God," she said.

"What?" said Ponter.

"Look at all those stars! I've never seen so many!" Mary pulled the car over to the side of the country road, getting it well up on the shoulder, out of the way of any traffic that might come along. "I've got to have a look." She got out of her car, and Ponter did the same. "It's gorgeous," said Mary, bending her neck backward and looking up.

"I always enjoy the night sky," said Ponter.

"I never get to see it like this," said Mary. "Not in Toronto." She snorted. "I live on a street called Observatory Lane,

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but you're lucky if you can see a few dozen stars on even the darkest winter night."

"We do not light up the outside world at night," said Ponter.

Mary shook her head in wonder, imagining not needing to have streetlights, not needing to protect yourself from your own kind. But suddenly her heart jumped. "There's something in the bush," she said softly.

She couldn't really see Ponter as anything more than a vague outline, but she could hear him inhale deeply. "Just a raccoon," he said. "Nothing to worry about."

Mary relaxed and tipped her head up to look at the stars some more. Her neck creaked a bit as she did so; it wasn't a comfortable posture. But then a memory came back to her from her teenage years. She stepped over to the Neon's front, and scooted her rear up onto the hood, then worked her way back until she was leaning comfortably against the windshield on the driver's side. She patted the hood next to her and said, "Here, Ponter. Have a seat."

Ponter moved in the dark and made his way up onto the hood as well, the metal groaning as it took his weight. He leaned back against the glass next to Mary.

"We used to do this when I was a kid," Mary said. "When my father took us camping."

"It *is* a great way to look at the sky," said Ponter.

"Isn't it, though?" said Mary. She let out a long contented sigh. "Look at the Milky Way! I've never seen it like that!"

"Milky Way?" said Ponter. "Oh, I see, yes. We call it the Night River."

"It's lovely," said Mary. She looked to her right. Ursa Major sprawled across the sky above the trees.

Ponter turned his head as well. "That pattern there," he said. "What do you call it?"

"The Big Dipper," said Mary. "Well, at least that part—those seven bright stars. That's what we call it here in North America. The Brits call it 'The Plow.'"

Bleep.

"A farming implement."

Ponter laughed. "I should have known. We call it the Head of the Mammoth. See? It is a profile. That is his trunk arching out from the block-shaped head."

"Oh, yeah—I see it. What about that one there? The zigzag shape?"

"We call it the Cracked Ice," said Ponter.

"Yeah. I can see that. We call it Cassiopeia; that's the name of an ancient queen. The shape is supposed to represent her throne."

"Umm, does not that pointy part in the middle hurt her bum?"

Mary laughed. "Now that you mention it . . ." She continued to look at the constellation. "Say, what's that smudge just below it?"

"That is—I do not know what name you give it; it is the closest large galaxy to ours."

"Andromeda!" declared Mary. "I've always wanted to see Andromeda!" She sighed again and continued to look up at the stars. There were more than she'd ever seen in her life. "It's so beautiful," she said, "and—oh, my. Oh, my! What's that?"

Ponter's face was now slightly illuminated. "The night lights," he said.

"Night lights? You mean the *northern* lights?"

"They are associated with the pole, yes."

"Wow," said Mary. "The northern lights! I've never seen them before, either."

There was surprise in Ponter's voice. "You haven't?"

"No. I mean, I live in Toronto. That's farther south than Portland, Oregon." It was a factoid that often astonished Americans, but probably didn't mean a thing to Ponter.

"I have seen them thousands of times," said Ponter. "But I never tire of

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them." They were both quiet for a time, enjoying the rippling curtains of light. "Is it common for your people to have not seen them?"

"I guess," said Mary. "I mean, there're not many of us who live in the extreme north—or south, for that matter."

"Perhaps that explains it," said Ponter.

"What?"

"Your people's unawareness of the electromagnetic filaments that shape the Universe; Lou and I spoke of this. It was in the night lights that we first identified such filaments; they, rather than this big bang of yours, are our way of explaining the structure of the Universe."

"Well," said Mary. "I don't think you're going to convince many people that the Big Bang didn't happen."

"That is fine. Feeling a need to convince others that you are right also is something that comes from religion, I think; I am simply content to know that I *am* right, even if others do not know it."

Mary smiled in the darkness. A man who cried openly, a man who didn't always have to prove he was right, a man who treated women with respect and as equals. *Quite a find,* as her sister Christine would say.

And, thought Mary, it was clear that Ponter liked her—and, of course, it *had* to be for her mind; she must appear as, well, as homely to him as he did to—no, not to her, not anymore, but to others here on this Earth. Imagine that: a man who really did like her for who she was, not what she looked like.

Quite a find, indeed, but—

Mary's heart skipped a beat. Ponter's left hand had found her right one in the dark, and had begun gently stroking it.

And suddenly she felt every muscle in her body tense up. Yes, she could be alone with a man; yes, she could hug and comfort a man; but—

But, no, it was too soon for that. Too soon. Mary retrieved her hand, hopped off the hood of the car, and opened the door, the dome light stinging her eyes. She got into the driver's seat, and, a moment later, Ponter entered from the passenger's side, his head downcast.

They drove the rest of the way back to Sudbury in silence.

Chapter 42

DAY EIGHT
Friday, August 9
148/119/02

NEWS SEARCH
Keyword(s): *Neanderthal*

The environmental group Emerald Dawn has claimed responsibility for the bombing of the Sudbury Neutrino Observatory. SNO Director Bonnie Jean Mah, however, says that no explosion occurred, blaming the destruction of her facility on a rapid infusion of air . . .

X-rays of Ponter Boddit's skull were put up for sale on eBay this morning. Bidding reached $355 before the online auction site pulled the offer, after a spokesperson for the Sudbury Regional Hospital said on CBC Radio that they must be fake . . .

The Canadian dollar dropped more than two-thirds of a cent yesterday as relationships between Canada and the United States continued to show signs of strain over the question of who should be controlling the fate of the interloping caveman . . .

Indications from the Montego encampment in Northern Ontario are that Neanderthals don't share all our scientific beliefs. Indeed, in what's sure to be a boon to creationists, the Neanderthals apparently reject the Big Bang, science's favorite explanation for the origin of the Universe . . .

Unconfirmed rumors today that Russia has targeted Northern Ontario with ICBMs carrying nuclear weapons. "If a plague has entered our world, some-

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body needs to stand ready to sterilize the infected area, for the greater good of all mankind," said a person signing himself as Yuri A. Petrov in an Internet newsgroup devoted to crossborder health issues . . .

Ponter Boddit has agreed to throw the first pitch at SkyDome next Thursday, when the Blue Jays face the New York Yankees . . .

"According to our CNN online poll, the top three questions people would like to ask the Neanderthal are: What are women like in your world? What happened to our kind of human in your world? And do you believe in Jesus Christ?"

Lurt, Adikor's woman-mate, had every right to view her own alibi archive whenever she wished. Indeed, she'd had cause to access it just a few months earlier, when a formula she'd written on the wallboard had accidentally been erased by an apprentice. Rather than trying to re-create it, she'd simply come to the archive building, accessed her alibi recording, found a good, clear view of the wallboard, and jotted down the string of symbols.

Because of this recent visit, Lurt knew that her alibi cube was plugged into receptacle 13,997; she told the Keeper of Alibis that, rather than having her look it up on the computer. The keeper accompanied Lurt to the correct niche, and Lurt faced her Companion toward the blue eye. "I, Lurt Fradlo, wish to access my own alibi archive for reasons of personal curiosity. Timestamp."

The eye turned yellow; the cube agreed that Lurt was indeed who she claimed to be.

The archivist held up her Companion. "I, Mabla Dabdalb, Keeper of Alibis, hereby certify that Lurt Fradlo's identity has been confirmed in my presence. Timestamp." The eye went bloodshot, and a tone emanated from the speaker.

"All set," said the keeper. "You can use the projector in room four." Dabdalb turned to go, and Lurt followed her. She entered room four, which was a small chamber with a single chair. Somewhere, in one of the other rooms, Lurt imagined an enforcer was watching Adikor's transmissions in real time as they were being received and recorded.

But watching as something was recorded was entirely different from trying to record and play back at the same time. Lurt pulled on control buds, selecting a day at random to review, and watched as the holo-bubble in front of her filled with banal pictures of her working in her lab. As the images played on, Lurt left the chamber, ostensibly heading for the washroom. And once she'd passed into a corridor that had no one else in it, she slipped on a pair of dining gloves, fished out the small device she'd brought with her, activated it, and dropped it into a recycling tub. She then removed the gloves.

Bolbay had been wrong, Lurt thought, whistling as she returned to the viewing chamber. Deep underground wasn't the perfect place to commit an unobserved crime. No, the perfect place was right here in the archive pavilion, when no one else was watching you and your own alibi cube was playing back instead of recording . . .

Her first thought had been to use hydrogen sulfide, which surely would have had the desired effect. But concentrations greater than 500 parts per million over even a short period could be fatal. She'd then considered polecat musk, but when she'd looked up the formula, it had been complex: trans-2-Butene-1-thiol, 3-Methyl-1-butanethiol, trans-2-Butenyl thioacetate, and more. Finally, she settled on ammonium sulfide, that favorite of prankster children who hadn't come to grips with the fact that their Companions were recording their actions.

Having a keen olfactory sense certainly had its advantages, although Lurt had

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heard it said that the reason people ate so few plants, while other primates thrived on them, was that the acute sensitivity to odors made it hard to tolerate the flatulence that went with a diet heavy in vegetation. Anyway, this was just what the doctor had ordered—even if that doctor was a physicist trying to keep from going under the knife.

Lurt thought she smelled it first, before anyone else, even though her viewing room was hardly the closest to the corridor where she'd left the device. Then again, she'd been waiting for it, doubtlessly dilating her nostrils in anticipation. But she refused to be the first one to react. She sat until she heard others running about, then left her room, trying not to gag at the horrendous stench. A big, burly fellow came out of one of the other viewing chambers, holding a hand over his nose. Lurt thought perhaps he was the enforcer monitoring Adikor's transmissions, and that was confirmed when, as she herself exited, she caught sight of the holo-bubble the man had been watching, which showed Jasmel and Adikor leaving Adikor's house.

"What *is* that awful smell?" said a wincing Dabdalb, the Keeper of Alibis, as Lurt passed her.

"It's horrible!" said another patron, hustling through the lobby.

"Open the windows! Open the windows!" shouted a third.

Lurt joined the small crowd hurrying out into the clean, open air outside the building. It would be at least a quarter of a day, Lurt knew, before the smell would dissipate enough to make going back indoors possible.

She hoped that would be enough time for Adikor to accomplish what he was trying to do.

Mary went to Laurentian University the next morning, having finally managed to get rid of the reporters waiting in the lobby of the Ramada. They'd been disappointed that Ponter hadn't turned out to be staying there, as well. Apparently, Reuben had implied to the journalists that he might be—presumably as a way of putting them off Ponter's trail; Mary had returned him to Reuben's house last night, which, as far as she knew, was where he'd stayed.

At 10:30 A.M., Mary was surprised to run into Louise Benoît in the corridor outside the Laurentian genetics lab. Louise was wearing tight-fitting denim cutoffs and a white T-shirt tied in a knot over her flat midriff. Well, thought Mary, it *was* blisteringly hot today, but *really*—she looks like she's *asking* for it . . .

No.

Mary cursed herself; she knew better than that. No matter how a woman dressed, she was entitled to safety, entitled to be able to walk around without being molested.

Mary decided to be friendly and trotted out her few words of French. *"Bonjour,"* she said, as she got closer to Louise. *"Comment ça va?"*

"I'm fine," replied Louise. "And you?"

"Fine. What brings you here?"

Louise pointed down the hall. "I was visiting some guys I know in the physics department. There's not much for me to do at SNO right now. They've finished draining the detector chamber, and a team from the original manufacturer is just beginning work on reassembling the sphere, although that will take weeks. So I thought I'd talk over an idea with a couple of the people here—see if they could shoot any holes in it."

Mary was heading toward the vending machines, looking to get a bag of Miss Vickie's sea-salt-and-malt-vinegar kettle chips—an indulgence she could only afford in a monetary sense, but it had long been traditional for her to start each work week with a 43-gram bag.

"And did they?" Mary asked. "Shoot any holes in it, I mean?"

Louise shook her head and fell in beside Mary as she continued on down to the lounge.

"Well, that's the best kind of idea, isn't

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it?" Mary said.

"I suppose," said Louise. Once they reached the lounge, Mary fished in her purse for some change. She pulled out a loonie and a quarter, and fed them into one of the vending machines. Louise, meanwhile, got herself a cup of coffee from another machine.

"Remember that meeting we had in the Inco conference room?" said Louise. "Well, as I said then, the many-worlds interpretation of quantum mechanics states that whenever a quantum event can go two ways, it *does* go two ways."

"A splitting of the timeline," said Mary, leaning her bum against the arm of a vinyl-padded chair in the lounge.

"Oui," said Louise. "Well, I spent some time talking to Ponter about this."

"Ponter mentioned that," said Mary. "I must have missed it."

"It was late at night, and—"

"You went into Ponter's room again after we'd finished the language lessons?" Mary was astonished by the rush of—of, my God, of *jealousy*—she felt.

"Sure. I like to be up at night; you know that. I wanted to learn more about the Neanderthal view of physics."

"And?" said Mary, trying to keep her tone even.

"Well, it's interesting," said Louise. She took a sip of her coffee. "Here in this world, we've got two major interpretations for quantum mechanics: the Copenhagen interpretation and Everett's Many-Worlds interpretation. The former postulates a special role for the observer—that consciousness actually influences reality. Well, that idea makes some physicists very uncomfortable; it's seen as a return to vitalism. Everett's Many-Worlds interpretation was an attempt to work around that. It says that quantum phenomena cause new universes to split off constantly, with each possible outcome of a quantum interaction occurring, but in a separate universe. No observers are required to shape reality; instead, every reality that *can* conceivably exist is automatically created."

"OK," said Mary, not because she really understood, but because the alternative seemed to be an even longer lecture.

"Well, Ponter's people have a *single* theory of quantum mechanics that's sort of a synthesis of our two theories. It allows for many worlds—that is, for parallel universes—but the creation of such universes doesn't result from random quantum events. Rather, it only happens through the *actions of conscious observers.*"

"Why don't we have the same single theory, then?" asked Mary, munching on a particularly large chip.

"Partly because there's a lot of math that seems irreconcilable between the two interpretations," said Louise. "And, of course, there's that old problem of politics in science: those physicists who favor the Copenhagen interpretation have devoted their careers to proving that it's right; same thing for the guys on Everett's side. For them all to sit down and say, 'Maybe we're both partly right—and both partly wrong' just isn't going to happen."

"Ah," said Mary. "It's like the Regional Continuity versus Replacement debate in anthropology."

Louise nodded. "If you say so. But suppose the Neanderthal synthesis of quantum physics is actually correct. It implies that consciousness—human volition—has the power to spin off new universes. Well, that raises a significant question. Presumably in the beginning, at the moment of the Big Bang, there must have been only *one* Universe. Sometime later, it started splitting."

"I thought Ponter didn't believe in the Big Bang?" said Mary.

"Yes, apparently Neanderthal scientists think the Universe has always existed. They believe that on large scales, redshifts—which are our principal evidence for an expanding universe—are proportional to age, rather than distance; that is, that mass varies over time. And they think the gross structure of galaxies and galactic clusters are caused

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by monopoles and plasma-pinching magnetic vortex filaments. Ponter says the cosmic microwave background—which we take as the residue of the big-bang fireball—is really the result of electrons trapped in these strong magnetic fields absorbing and emitting microwaves. Repeated absorption and emission by billions of galaxies smoothed out the effect, he says, producing the uniform background we detect now."

"Does that seem possible to you?" asked Mary.

Louise shrugged. "I'm going to have to look into it." She took another sip of coffee. "But, you know, after telling me all that, Ponter said the most astonishing thing."

"What?" asked Mary.

"I guess you showed him a church service, right?"

"Yes. On TV."

Louise took a seat on one of the other vinyl-covered chairs. "Well," she said, "apparently he spent some time that night watching Vision TV, soaking up more religious thought. He said our story of the Universe having an origin is just a creation myth, like from the Bible. 'In the beginning God created the Heavens and the Earth . . .' and all that. 'Even your science,' Ponter said, 'is contaminated by this error of religion.'"

Mary sat down properly as well. "You know . . . I mean, physics is your field, not mine, but maybe he's right. I mentioned Regional Continuity versus Replacement a moment ago; sometimes that's called Multiregionalism versus Out-of-Africa. Anyway, there are those who've observed that Replacement, which is what I and other geneticists favor, is also basically a biblical position: humanity came full-blown out of Africa, ejected from a garden, and there's a hard-and-fast line between us and everything else in the animal kingdom, including even other contemporaneous members of the genus *Homo*."

"It's an interesting point of view," said Louise.

"And you can argue that the other side is fighting for a biblical interpretation, too: the parallels between Multiregionalism and the Ten Lost Tribes of Israel are pretty blatant. Beyond that, there's that the whole 'mitochondrial Eve' hypothesis—that all modern humans trace their origin to one woman who lived hundreds of thousands of years ago. Even the theory's name—Eve!—screams that it's being pushed more because of biblical resonances than because it's good science." Mary paused. "Anyway, sorry, you were talking about the Neanderthal version of quantum physics . . ."

"Right, right," said Louise. "Well, my thought was, suppose they are correct about how parallel universes are spun off, but wrong about this Universe having existed forever. If the Universe *did* have a beginning, then when did that first split occur?"

Mary frowned. "Well, umm, I don't know. I guess the first time somebody made a decision."

"Exactly! I think that's exactly right! And when was the first decision made?" Louise paused. "You know, it *is* interesting what Ponter says about how our scientific worldview is always, down deep, trying to say the same things our creation myths say—the Big Bang and your model of hominid evolution both being modern retellings of Genesis. Well, maybe I'm being guilty of the same kind of thinking here. After all, in the Bible, the first decision made by anyone other than God is when Eve decided to take the apple—the original sin—and, well, one could think of that as having split the Universe. In one timeline, the one we're supposedly in, humanity was cast out of paradise. In another, we weren't. In fact, it's even a bit like Ponter's own case, with a being crossing over from one version of reality to the other."

Mary was completely lost. "How do you mean?"

"I'm talking about Mary—not you,

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Professor Vaughan; Mary, the mother of Jesus. You're a Catholic, aren't you?"

Mary nodded.

"I noticed your crucifix." Mary looked down, self-conscious. "I'm Catholic, too," continued Louise. "Anyway, as a Catholic, you probably don't make the same mistake lots of other people do. The doctrine of the immaculate conception—a lot of people think that's a fancy term for Christ's virgin birth, but it isn't, is it?"

"No," said Mary. "No, it refers to the conception of Mary herself. The reason she was able to give birth to the son of God was that she herself was conceived devoid of original sin—it was *her* conception that was immaculate."

"Exactly. Well, how do you get a person without original sin in a world in which everyone is descended from Adam and Eve?"

"I have no idea," said Mary, truthfully.

"Don't you see?" said Louise. "It's as if Mary was shifted into this Universe from the other timeline, from the one in which Eve never took the apple, the one in which Man never fell, the one in which people live without the taint of original sin."

Mary nodded dubiously. "One *could* argue that."

Louise smiled. "Well, you'll see the parallel between Ponter and the Virgin Mary in a second. Let me get back to my earlier question: I said if he's right, and the Universe does split every time a decision is made, when did the Universe first split? And you said the first time someone made a decision. But when was that? Not in the Bible, but, well, in reality . . . ?"

Mary fished out another potato chip. "Gee, I don't know. The first time a trilobite decided to go left instead of right?"

Louise put her cardboard coffee cup down on a little table. "No, I don't think so. Trilobites have no volition; they, and all other primitive forms of life, are just chemical machines. Stephen Jay Gould keeps talking about rewinding the tape of life in his books and getting a different outcome, and when he says that, he thinks he's making an allusion to chaos theory. But he's wrong. No matter how many times you placed a trilobite at the same fork in the road, it will go the same way. A trilobite doesn't think; it doesn't have consciousness. It just processes the inputs of its senses and does what they dictate. No choice is made. Gould is right—sort of—that if the initial conditions were changed, the outcome could be radically different, but rewinding the tape of life and playing it again no more gives a different outcome than rewinding a tape of *Gone with the Wind* and playing it again results in an ending in which Rhett and Scarlett stay together. I don't think real decisions—real choices, real *consciousness*—emerged until much, much later. I think *we—Homo sapiens*—were the first conscious beings on this planet."

"There was lots of sophisticated behavior by earlier forms of humans," said Mary. "*Homo ergaster*, *Homo erectus*, *Homo habilis*, even the australopithecines and *Kenyanthropus*."

"Well, I realize this is your field, Professor Vaughan—" Had she really in all the time they'd spent quarantined together never volunteered that Louise could call her Mary?—"but I've been reading up on this on the Web. As far as I can tell, those earlier kinds of man didn't really have behavior any more sophisticated than a beaver building a dam."

"They made tools," said Mary.

"Oui," said Louise. "But weren't they repetitive, virtually identical tools, turned out over the centuries by the thousands? All made to the same mental template, the same design?"

Mary nodded. "That's true."

"Surely there has to be some natural variation among stone tools," said Louise, "just based on chance accidents and random differences that occur when implements are chipped from stone. If there *was* consciousness at work, even without coming up with a

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better idea on their own, early humans should have seen that some tools happened to be better than others. It's like you don't have to think of the round wheel right off the bat; you might start with a five-sided one, then accidentally make a six-sided one—and note that it rolled slightly better. Eventually, you'd come up with the perfectly round one."

Mary nodded.

"But if there's no consciousness at work," said Louise, "you simply toss aside the better version as not fitting your mental template of what was supposed to be produced. Right? And that's what happens with the tools in the archeological record: instead of gradual refinement over time, they just stay the same. And the only explanation I can think of for that is that there was no conscious selection of better variants: the toolmaker simply wasn't *aware;* he couldn't see that *this* particular way of hitting nodules produced something better than *that* way. The design was frozen."

"Interesting take," said Mary, genuinely impressed.

"And when we see complex repetitive behavior in other animals—such as building a dam—we call it instinct, and that's what that kind of toolmaking was. No, until *Homo sapiens*, there was no consciousness, and—here's the kicker—in fact, for the first sixty thousand years that *Homo sapiens* existed, *there was no consciousness.*"

"What are you talking about?" said Mary.

"When did anatomically modern humans first appear?" asked Louise, picking up her coffee cup again.

"About one hundred thousand years ago."

"That's the same figure I saw on the Web. Now, do I understand that right? A hundred-K years in the past, creatures that looked exactly like us, that walked exactly like us, first appeared, right? Creatures with brains that were the same size and shape as our brains, judging by their cranial cavities?"

"That's right," said Mary. She'd finished her chips, and got some Kleenex out of her purse so she could wipe her greasy fingers.

"But," said Louise, "according to what I read, for sixty thousand years, they thought no thoughts. For sixty thousand years, they did nothing that wasn't instinctual. But then, forty thousand years ago, everything changed."

Mary's eyes went wide. "The Great Leap Forward."

"Exactly!"

Mary felt her heart pounding. The Great Leap Forward was the term some anthropologists gave to the cultural awakening that occurred 40,000 years ago; others called it the Upper Paleolithic Revolution. As Louise had said, modern-looking human beings had been around for six hundred centuries by that point, but they created no art, they didn't adorn their bodies with jewelry, and they didn't bury their dead with grave goods. But starting simultaneously 40,000 years ago, suddenly humans were painting beautiful pictures on cave walls, humans were wearing necklaces and bracelets, and humans were interring their loved ones with food and tools and other valuable objects that could only have been of use in a presumed afterlife. Art, fashion, and religion all appeared simultaneously; truly, a great leap forward.

"So you're saying that some Cro-Magnon 40,000 years ago suddenly started making choices, and the Universe started splitting?"

"Not exactly," said Louise. She'd evidently finished her first coffee; she got up and bought a second one. "Think about this: what *caused* the Great Leap Forward?"

"Nobody knows," said Mary.

"For all intents and purposes, it's a marker, right there in the archeological record, showing the dawn of consciousness, wouldn't you say?"

"I suppose," said Mary.

"But that dawning isn't accompanied

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by any gross physical change; it's not like a new form of humanity appeared who suddenly started making art. Brains *capable* of consciousness had existed for sixty thousand years, but they *weren't* conscious. And then something happened."

"The Great Leap Forward, yes. But, as I said, no one knows what caused it."

"You ever read Roger Penrose? *The Emperor's New Mind?*"

Mary shook her head.

"Penrose is an Oxford mathematician. He contends that human consciousness is quantum-mechanical in nature."

"Meaning what?"

"Meaning that what we think of as intelligence, as sentience, doesn't arise from some biochemical network of neurons, or anything as crude as that. Rather, it arises from quantum processes. Specifically, he and an anesthesiologist named Hameroff argue that quantum superposition of isolated electrons in the microtubules of brain cells creates the phenomenon of consciousness."

"Ah," said Mary dubiously.

Louise sipped some of her new coffee. "Well, don't you see?" she said. "*That* explains the Great Leap Forward. Sure, our brains had been just as they are today since one hundred thousand years ago, but consciousness didn't begin until a quantum-mechanical event occurred, presumably at random: the one and only spinning off of a new universe that happened the way Everett thinks it does."

Mary nodded; it *was* an interesting notion.

"And quantum events, by their very nature, have *multiple* possible outcomes," said Louise. "Instead of that quantum fluctuation, or whatever it was, creating consciousness in *Homo sapiens*, the same thing might have happened in the other kind of humanity that existed 40,000 years ago—Neanderthal man! The first splitting of the Universe was an accident, a quantum fluke. In one branch, thought and cognition arose in our ancestors; in another, it arose in Ponter's ancestors. I read that Neanderthals had been around since maybe 200,000 years ago, right?"

Mary nodded.

"And they had even bigger brains than we did, right?"

Mary nodded again.

"But on this world," said Louise, "in this timeline, those brains never sparked with consciousness. Ours did instead, and the edge that consciousness gave us—cunning and foresight—led to us absolutely triumphing over the Neanderthals, and becoming rulers of the world."

"Ah!" said Mary. "But in Ponter's world—"

Louise nodded. "In Ponter's world, the opposite happened. It was Neanderthals who became conscious, developing art and culture—and cunning; they took the Great Leap Forward while we remained the dumb brutes we'd been for the preceding sixty thousand years."

"I suppose that's possible," said Mary. "You could probably get a good paper out of that."

"More than that," said Louise. She sipped some more coffee. "If I'm right, it means Ponter might get to go home."

Mary's heart fluttered. "What?"

"I'm basing this in part on stuff Ponter told me, and in part on our own world's understanding of physics. Suppose that each time the Universe splits, it doesn't do it the way amoebas do—with one amoeba becoming two daughters, and the parent disappearing in the process. Suppose instead it happens more like vertebrates giving birth: the original universe continues on, and a new daughter universe is created."

"Yes?" said Mary. "So?"

"Well, then, you see, universes actually are of different ages. They might *appear* absolutely identical, except for your choice of breakfast this morning, but one of them is twelve billion years old, and the other is"—she looked at her watch—"well, a few hours old now. Of

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course, the daughter universe would *seem* to be billions of years old, but it wouldn't really be."

Mary frowned. "Umm, Louise, you're not by any chance a creationist, are you?"

"Quoi?" But then she laughed. "No, no, no—but I see the parallel you're alluding to. No, I'm talking real physics here."

"If you say so. But how does this get Ponter home?"

"Well, assume this Universe, the one you and I are in right now, *is* the original one in which *Homo sapiens* became conscious—the one that initially split from the universe in which Neanderthals became conscious instead. All the other googolplex of universes in which conscious *Homo sapiens* exist are daughters, or granddaughters, or great-great-great-great-granddaughters, of this one."

"That's a huge assumption," said Mary.

"It would be, if we had no other evidence. But we *do* have evidence that this particular Universe is special—Ponter's arrival here, out of all the places he might have gone. When Ponter's quantum computer ran out of universes in which other versions of itself existed, what did it do? Why, it reached across to universes in which it *didn't* exist. And, in doing so, it latched first onto the one that had initially split from the entire tree of those in which it did exist, the one that, forty thousand years previously, had started on another path, with another kind of humanity in charge. Of course, as soon as it reached a universe in which a quantum computer didn't exist in the same spot, the factoring process crashed and the contact between the two worlds was broken. But if Ponter's people repeat the exact process that led to him being marooned here, I think there's a real chance that the portal to this specific Universe, the one that first split from their timeline, will be re-created."

"That's a lot of ifs," said Mary. "Besides, if they *could* repeat the experiment, why haven't they already?"

"I don't know," said Louise. "But if I'm right, the doorway to Ponter's world may open again."

Mary felt her stomach fluttering—and not just because of the potato chips—as she tried to sort out her feelings about that possibility.

Chapter 43

Adikor Huld stared at the mining robot Dern had provided. It was a sorry-looking contraption: just an arrangement of gears and pulleys and mechanical pincers, vaguely resembling a stubby pine tree denuded of needles. The robot had obviously endured a fire at some point; there had been one in the mine about four months ago, Adikor recalled. Some of the robot's components had fused, some metal parts were extensively fatigued, and the whole thing had a blackened, sooty look to it. Dern had said this unit was to have been sent to the recycling yards, anyway, so no one would mind if it were lost.

It was tricky determining how to control the robot, though. Although there were robots with artificial intelligence, they were very expensive. This one didn't have the smarts to do what needed to be done on its own; it would have to be operated by remote control. They couldn't use radio signals; those would interfere with the quantum registers, ruining the attempt to reproduce the experiment. Dern finally decided to simply run a fiber-optic cable from the robot's torso back into a small control box, which he perched on a console in the quantum-computing control room. He used twin joysticks to move the robot's hands, having the machine press down on the top of register 69 just as Ponter had originally done.

Adikor looked at Dern. "All set?"

Dern nodded.

He looked at Jasmel, who was also present. "Ready?"

"Yes."

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"Ten," said Adikor, standing next to his control unit; he shouted the countdown just as he had the first time, even though there was no one out on the computing floor to hear him.

"Nine." He desperately hoped this would work—for Ponter's sake, and for his own.

"Eight. Seven. Six."

He looked at Dern.

"Five. Four. Three."

He smiled encouragingly at Jasmel.

"Two. One. Zero."

"Hey!" shouted Dern. His control box jerked off the desk and clattered to the floor, skittering across it as the fiber-optic cable coming out of its back end was pulled tight.

Adikor felt a great wind swirling about, but his ears didn't pop; there was no significant change in pressure. It was as if air was simply being *exchanged* . . .

Jasmel's mouth formed the words, "I don't believe it," but whatever sound she was making was drowned out by the wind.

Dern, dashing across the room, had stopped the console from being pulled farther by clamping down on its cable with his right foot. Adikor hurried over to the window to look down on the computing floor.

The robot was *gone*, but—

—but the cable was pulled taut, half an armspan above the floor, stretching from the open control-room door to three-quarters of the way across the computing facility, until—

Until it *disappeared*, into thin air, as if through an invisible hole in an invisible wall, right next to register column 69.

Adikor looked at Dern. Dern looked at Jasmel. Jasmel looked at Adikor. They hurried over to the monitor, which should be displaying whatever the robot's camera eye was seeing. But it was just an empty, black square.

"The robot's been destroyed," said Jasmel. "Just like my father."

"Maybe," said Dern. "Or maybe video signals can't travel through that—whatever that is."

"Or else," said Adikor, "maybe it's just emerged into a completely dark room."

"What—what do you suppose we should do?" asked Jasmel.

Dern shrugged his rounded shoulders slightly.

Adikor said, "Let's haul it back in—see if anything can survive going . . . going *through*." He walked out onto the computing floor and gently took hold of the cable, disappearing a few paces away into nothingness at waist height. He added his other hand and began to pull gently.

Jasmel came over to be behind him, and she began to pull gently as well.

The cable was hauling back easily enough, but it was obvious to Adikor, at least, that there was a weight hanging off the end, as if, somewhere on the other side of the hole, the robot was dangling over a precipice.

"How strong are the connectors on the robot's end of the cable?" asked Adikor, shooting a glance at Dern, who, now that he no longer had to hold down his control box, had come out onto the computing floor as well.

"They're just standard *bedonk* plugs."

"Will they come free?"

"If you jerk them hard enough. There are little clips that snap onto the cable's connector to help hold it in place."

Adikor and Jasmel continued to pull gently. "And did you engage the clips?"

"I—I'm not sure," said Dern. "I mean, maybe. I was plugging and unplugging the cable a fair bit as I set the robot up . . ."

Adikor and Jasmel had already hauled in perhaps three armspans' worth of cable, and—

"Look!" said Jasmel.

The robot's squat form was emerging through—well, through *what* they couldn't say. But the machine's base was now visible, as if somehow it were passing through a hole in midair that precisely matched the robot's cross-section.

Dern hurried across the computing chamber, the closed ends of his pant

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making loud slapping sounds against the polished rock of the floor. He reached out and grabbed one of the robot's spindly arms, now partially protruding from the air. He was just in time, too, for the cable connector did give way, and Adikor and Jasmel went tumbling backwards, him falling on her. They quickly got to their feet and saw Dern finish pulling the robot through from—the phrase came again into Adikor's mind—from the other side.

Adikor and Jasmel ran over to join Dern, who was now sitting on the floor, the robot, toppled over, next to him. It seemed no more damaged than it had been before it had gone through. But Dern was staring at his own left hand, a dumbfounded look on his face.

"Are you all right?" asked Adikor.

"My hand . . ." said Dern.

"What about it? Is it broken?"

Dern looked up. "No, it's fine; it's fine. But—but when I first grabbed hold of the robot . . . when the cable came loose, and the robot fell backward, my hand passed *through*. I saw half of it disappear through . . . through whatever that was."

Jasmel took Dern's hand in hers and peered at it. "It looks all right. What did it feel like?"

"I didn't feel anything. But it looked like it was cut off, right behind the fingers, and the edge was absolutely straight and smooth, but there was no bleeding, and the edge kept moving down my fingers as I pulled my hand back."

Jasmel shuddered.

"You're sure you're all right?" asked Adikor.

Dern nodded.

Adikor took a half step forward, toward where the opening had been. He slowly stretched his right arm out and tentatively swept it back and forth. Whatever door had been open appeared to be closed now.

"Now what?" asked Jasmel.

"Well, I don't know," said Adikor. "Could we get a lamp to put on the robot?"

"Sure," said Dern. "I could take one off a head protector. Do you have extras?"

"On a shelf in the little eating room."

Dern nodded, then held up his hand and rotated it from the wrist, now palm up, now palm down, as if he'd never seen it before. "It was incredible," he said softly. Then, shaking his head slightly to break his own reverie, he headed off to get the lamp.

"You know what happened, of course," said Jasmel, as they waited for Dern to return. "My father went through whatever that was. That's why there's no trace of his body."

"But the other side isn't at ground level," said Adikor. "He must have fallen and—"

Jasmel raised her eyebrow. "And maybe broken his neck. Which . . . which means what we might see on the other side is . . ."

Adikor nodded. "Is his dead body. That thought had occurred to me, I'm sorry to say . . . but, actually, I'd expected to see him drowned in a tank of heavy water." He reflected on this for a moment, then moved over to the robot, which was bone dry. "There was a reservoir of heavy water on the other side when Ponter went through, and—*gristle!*"

"What?"

"We must have connected to a *different* universe, not the one Ponter went to."

Jasmel's lower lip quivered.

Adikor hoisted the robot onto its treads. He checked out the cable connector, but, as far as he could tell, it was in fine shape. Jasmel, meanwhile, had gone off, walking slowly, head down, to get the loose end of the fiber-optic cable; she brought it to Adikor, who snapped it into place. He then brought down the two clamps that clicked into notches on the connector's edge, helping to hold it in place.

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At this point, Dern returned with two electric lamps and the spherical battery packs that powered them. He also had a coil of adhesive tape, and he used this to firmly attach the lamps on either side of the robot's camera eye.

They repositioned the robot exactly as it had been before, right beside register 69, and then the three of them headed back into the control room. Adikor got some equipment boxes and stood on them so that he could simultaneously operate his console and look back over his shoulder onto the computing floor.

He called out the countdown once more: "Ten. Nine. Eight. Seven. Six. Five. Four. Three. Two. One. Zero."

This time, Adikor saw the whole thing. The portal opened like an expanding hoop of blue fire. He heard air rushing around again, and the robot, which seemed to be right on the lip of a precipice, tottered over and disappeared. The control cable went taut, and the blue hoop contracted around its perimeter, then disappeared.

The three of them turned as one to the square video monitor. At first it seemed again that there was no video signal at all, but then the light beams must have caught something—glass or plastic—and they briefly saw a reflection bouncing back at them. But that was all; whatever space the robot was dangling into must be huge.

The lights played across something else—intersecting metallic tubes?—as the robot swung back and forth like a pendulum.

And then, suddenly, there was illumination everywhere, as if—

"Someone must have turned on the lights," said Jasmel.

It was now clear that the robot was actually twirling at the end of its tether. They caught glimpses of rocky walls, and more rocky walls, and—

"What's that?" exclaimed Jasmel.

They'd only seen it for an instant: a ladder of some sort, leaning against the curving side of the vast chamber, and, scuttling down the ladder, a slight figure in some sort of blue clothing.

The robot continued to rotate, and they saw that a large geodesic latticework was sitting on the floor, with things like metal flowers at its intersections.

"I've never seen anything like that," said Dern.

"It's beautiful," said Jasmel.

Adikor sucked in his breath. The view was still swinging, and it showed the ladder again, two more figures coming down it, and then, maddeningly, the figures disappeared as the robot turned away.

Its rotation offered two more tantalizing glimpses of figures wearing loose-fitting blue body suits, and sporting bright yellow shells on top of their heads. They were way too narrow-shouldered to be men; Adikor thought perhaps they were women, although they were thin even for females. But their faces, glimpsed ever so briefly, seemed devoid of hair, and—

And the image jerked suddenly, then settled down, the robot no longer rotating. A hand had reached in from the side, briefly dominating the camera's field of view, a strange, weak-looking hand with a short thumb and some sort of metal circle wrapped around one finger. The hand had clearly clamped onto the robot, steadying it. Dern was working frantically with his control box, tipping the camera down as fast as it would go, and they got their first good look at the face of the being now reaching up and clutching the hanging robot.

Dern gasped. Adikor felt his stomach knotting. The creature was *hideous*, deformed, with a lower jaw that protruded as if the bone within were encrusted by growths.

The repulsive being was still holding on to the robot, trying to pull it down, closer to the ground; the robot's treads seemed to be about half a bodylength above the floor of the vast chamber.

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As the robot's camera tilted, Adikor could see that there was an opening in the bottom of the geodesic sphere, as if part of it had been disassembled. Lying on the chamber's floor were giant, curved pieces of glass or transparent plastic piled up one atop another; they must have been what had originally caught the robot's lamps. Those curved pieces of glass looked like they might have once formed a huge sphere.

They could now intermittently see three of the same beings, all equally deformed. Two of them were also devoid of facial hair. One was pointing directly at the robot; his arm looked like a twig.

Jasmel placed her hands on her hips and shook her head slowly back and forth. "What *are* they?"

Adikor shook his head in wonder.

"They're primates of some sort," said Jasmel.

"Not chimpanzees or bonobos," said Dern.

"No," said Adikor, "although they're scrawny enough. But they're mostly hairless. They look more like us than like apes."

"It's too bad they're wearing those strange pieces of headgear," said Dern. "I wonder what they're for?"

"Protection?" suggested Adikor.

"Not very efficient, if so," said Dern. "If something fell on their heads, their necks, not their shoulders, would take the weight."

"There's no sign of my father," said Jasmel, sadly.

All three of them were quiet for a time. Then Jasmel spoke again. "You know what they look like? They look like primitive humans—like those fossils you see in *galdarab* halls."

Adikor took a couple of steps backward, literally staggered by the notion. He found a chair, spun it around on its base, and lowered himself into it.

"Gliksin people," he said, the term coming to him; Gliksin was the region in which such fossils—the only primates known without browridges and with those ridiculous protuberances from the lower jaw—had first been found.

Could their experiment have reached across *world lines*, accessing universes that had split from this one long before the creation of the quantum computer? No, no. Adikor shook his head. It was too much, too crazy. After all, the Gliksin people had gone extinct—well, the figure half a million months ago popped into his head, but he wasn't sure if it was correct. Adikor rubbed the edge of his hand back and forth above his browridge. The only sound was the drone of the air-purification equipment; the only smells, their own sweat and pheromones.

"This is huge," Dern said softly. "This is gigantic."

Adikor nodded slowly. "Another version of Earth. Another version of humanity."

"It's talking!" exclaimed Jasmel, pointing at one of the figures visible on the screen. "Turn up the sound!"

Dern reached for a control. "Speech," said Adikor, shaking his head in wonder. "I'd read that Gliksin people were incapable of speech, because their tongues were too short."

They listened to the being talking, although the words made no sense.

"It sounds so strange," said Jasmel. "Like nothing I've ever heard before."

The Gliksin in the foreground had stopped pulling on the robot, evidently realizing that there was no more cable to be payed out. He moved away, and other Gliksins loomed in to have a look. It took Adikor a moment to realize that there were both males and females present; both kinds mostly had naked faces, although a few of the men did have beards. The females generally seemed smaller, but, on a few at least, the breasts were obvious beneath the clothes.

Jasmel looked out at the computing floor. "The gateway seems to be staying open just fine," she said. "I wonder how long it can be maintained?"

Adikor was wondering that, too. The

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proof, the evidence that would save him, and his son Dab, and his sister Kelon, was right there: an alternative world! But Daklar Bolbay would doubtless claim the pictures, being recorded on video of course, were fake, sophisticated computer-generated imagery. After all, she'd say, Adikor had access to the most powerful computers on the planet.

But if the robot could bring back something—*anything!* A manufactured object, perhaps, or . . .

Different parts of the chamber were selectively revealed as people moved about, briefly opening up views of what was behind them. It was a barrel-shaped cavern, maybe fifteen times as tall as a person, and hewn directly out of the rock.

"They certainly are a varied lot, aren't they?" Jasmel said. "There seem to be several different skin tones—and look at that female, there! She has *orange* hair—just like an orangutan!"

"One of them is running away," said Dern, pointing.

"So he is," said Adikor. "I wonder where he's going?"

"Ponter! *Ponter!*"

Ponter Boddit looked up. He was sitting at a table in the dining hall at Laurentian, with two people from the university's physics department, who were helping him over lunch to work out an itinerary for a tour of physical-science installations worldwide, including CERN, the Vatican Observatory, Fermilab, and Japan's Super-Kamiokande, the world's other major neutrino detector, which had recently been damaged in an accident of its own. A hundred or so summer students were staring at the Neanderthal from a short distance away, in obvious fascination.

"Ponter!" Mary Vaughan shouted again, her voice ragged. She almost collapsed against the table as she came up to it. "Come quickly!"

Ponter started to get up. So did the two physicists. "What is it?" asked one of them.

Mary ignored the man. *"Run!"* she gasped at Ponter. "Run!"

Ponter began to run. Mary grabbed his hand and began running as well. She was still panting for breath; she'd already run all the way from the genetics lab, over in the Science One building, where she'd received the call from SNO.

"What is happening?" asked Ponter.

"A portal!" she said. "A device—some sort of robot or something—has come through. And the portal's still open!"

"Where?" said Ponter.

"Down in the neutrino observatory." She moved her hand to the center of her chest, which was heaving up and down. Ponter, Mary knew, could easily outpace her. Still running, she fumbled open her small purse and fished out her car keys, offering them to him.

Ponter shook his head slightly. For a second, Mary thought he was saying, *Not without you.* But it was surely more basic than that: Ponter Boddit had never driven a car in his life. They continued to run, Mary trying to keep up with him, but his stride was longer, and he'd only just started running, and—

He looked at her, and it was obvious that he also sensed the dilemma: there was no point in beating Mary to the parking lot, since there was nothing he could do there until she arrived.

He stopped running, and she did, too, looking at him with concern.

"May I?" said Ponter.

Mary had no idea what he meant, but she nodded. He reached out with his massive arms and scooped her up from the ground. Mary draped her arms around his thick neck, and Ponter began to run, his legs pounding like pistons against the tiled floor. Mary could feel his muscles surging as he barreled along. Students and faculty stopped and stared at the spectacle.

They came to the bowling alley, and Ponter put all his strength into running, surging forward, the sound of his massive footfalls thundering in the glass-

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walled corridor. Farther and farther, past the kiosks, past the Tim Hortons, and—

A student was coming through a door from outside. His mouth went wide, but he held the glass door open for Ponter and Mary as they surged into the daylight.

Mary's perspective was to the rear, and she saw divots flying up in Ponter's wake. She squeezed tighter, holding on. Ponter knew her car well enough; he'd have no trouble spotting the red Neon in the tiny lot—one of the advantages of a small university. He continued to run, and Mary heard and felt the change of terrain as he bounded off the grass onto the asphalt of the parking lot.

After a dozen meters, he slowed and swung Mary to the ground. She was dizzy from the wild ride, but managed to quickly cover the short remaining distance to her car, her electronic key out, the doors clicking open.

Mary scrambled into the driver's seat, and Ponter got into the passenger's seat. She put the key into the ignition, flattened the accelerator to the floor, and off they shot down the road, leaving Laurentian behind. Soon they were out of Sudbury, heading for the Creighton Mine. Mary usually didn't speed—not that there was much opportunity to in Toronto's gridlock—but she was doing 120 km/h along the country roads.

Finally, they came to the mine site, racing past the big Inco sign, through the security gate, and careening down the winding roads to the large building that housed the lift leading down to the mine. Mary skidded the car to a halt, sending a spray of gravel into the air, and Ponter and she both hurried out.

Now, though, there was no further need for Ponter to wait for Mary—and time was still of the essence. Who knew how long the portal would stay open; indeed, who knew if it even still *was* open? Ponter looked at her, then surged forward and grabbed her in a hug. "Thank you," he said. "Thank you for everything."

Mary squeezed him back hard—hard for her, as hard as she could, but presumably nothing like what a Neanderthal woman could have done.

And then she released him.

And he ran off toward the elevator building.

Chapter 44

Adikor, Jasmel, and Dern continued to stare at the monitor, at the scene taking place a few armspans—and an infinity—away.

"They're so fragile-looking," said Jasmel, frowning. "Their arms are like sticks."

"Not that one," said Dern, pointing. "She must be pregnant."

Adikor squinted at the screen. "That's not a woman," he said. "It's a man."

"With a belly like that?" said Dern, incredulously. "And I thought I was fat! Just how much do these Gliksins eat?"

Adikor shrugged. He didn't want to spend time talking; he just wanted to look, to try to soak it all in. Another form of humanity! And a technologically advanced one, at that. It was incredible. He'd love to compare notes with them on physics, on biology, and—

Biology.

Yes, that's what he needed! The robot had been touched by several Gliksins now. Surely some of their cells had rubbed off onto its frame; surely some of their DNA could be recovered from it. That would be proof that Adjudicator Sard would have to accept! Gliksin DNA: proof that the world shown on the screen was real. But—

There was no guarantee that the portal would stay open much longer, or that it could ever be reopened again. But at least he would be exonerated, and Dab and Kelon would be spared mutilation.

"Reel the robot back in," Adikor said.

Dern looked at him. "What? Why?"

"There's probably some Gliksin DNA on it now. We don't want to lose that if the portal closes."

Dern nodded. Adikor watched him

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walk across the room, take hold of the fiber-optic cable, and give it a gentle tug. Adikor turned back to the square monitor. The Gliksin nearest the robot—a brown-skinned specimen, probably a male—looked startled as the robot jerked upward.

Dern gave another tug. The brown Gliksin was looking back over his shoulder now, presumably at another person. He shouted something, then he nodded as somebody shouted back at him. He then grabbed onto the bottom of the robot's rising frame, now dangling most of the man's height off the ground.

Another male Gliksin ran into the field of view. This one was shorter, with lighter skin—as light as Adikor's own—but his eyes were . . . strange: dark, and half-hidden under unusual lids.

The brown Gliksin looked at the newcomer. The newcomer was shaking his head vigorously—but not at the brown one. No, he was looking directly up into the robot's glass lens, and making a wild motion with his arms, holding both hands flat out, palms down, and swiping them back and forth in front of his chest. And he kept shouting a single syllable over and over again: *"Wayt! Wayt! Wayt!"*

Of course, thought Adikor, they, too, were anxious to have an artifact to prove what they'd seen; doubtless they didn't want to give up the robot. He turned his head and shouted out to Dern. "Keep hoisting!"

Mary Vaughan finally caught up with Ponter at the far end of the elevator building, past the area where miners changed into their work clothes. Ponter was standing on the ramp leading down to the lift entrance—but the metal grating over the lift shaft was closed; the cage could have been anywhere, even down at the lowest drift, 7,400 feet below. Still, Ponter had evidently persuaded the operator to bring it up now—but it could be several minutes before it reached the surface.

Neither Ponter nor Mary had any authority here, and the mine's safety rules were posted *everywhere;* Inco had an enviable record for accident prevention. Ponter had already put on safety boots and a hardhat. Mary walked away from the ramp and put on a hardhat and boots, as well, selected from a vast rack of such supplies. She then moved back to stand next to Ponter, who was tapping his left foot in impatience.

At last the lift cage arrived, and the door was hoisted. There was no one inside. Ponter and Mary entered, the operator here at the top sounded the buzzer five times—express descent with no stops—and the cab lurched into motion.

Now that they were going down, there was no way to communicate with the SNO control room—or anyone else, except the lift operator, and he could only be signaled with a buzzer. Mary had said little to Ponter on the hair-raising drive over, partly because she'd been trying to concentrate on keeping the vehicle under control, and partly because her heart had been racing at least as fast as her car's engine.

But now—

Now she had an extended time with nothing to do while the elevator dropped a mile and a quarter straight down. Ponter would probably run off as soon as the cage reached the 6,800-foot level, and she couldn't blame him. Slowing so she could keep up would delay him by crucial minutes as he covered the three-quarters of a mile to the SNO cavity.

Mary watched as level after level flashed by. It was, after all, a fascinating spectacle that she'd never seen before, but . . .

But this might well be her final chance to talk to Ponter. On the one hand, the trip down seemed to be taking an enormous amount of time. On the other, hours, days—or maybe even years—wouldn't be enough to say all the things Mary wanted to say.

She didn't know where to begin, but

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she was sure she'd never forgive herself if she didn't tell him now, didn't make him understand. It wasn't as if he were disappearing into prehistoric time, after all; he'd be going *sideways*, not backwards. Tomorrow would be tomorrow for him, too, and the tenth anniversary of the day they'd met would be simultaneous on both versions of Earth—although he'd probably note it on the hundredth month, or some such date. Still, Mary had no doubt that he would reflect and wonder and feel sad, trying to piece together his emotions, and hers—trying to understand what had transpired, and, just as importantly, what had failed to transpire between them.

"Ponter," she said. The word was soft, and the clattering of the lift was loud. Perhaps he didn't hear. He was looking out the cage door, absently watching the dark rock speeding by as they plummeted farther and farther.

"Ponter," Mary said again, more loudly.

He turned to her, and his eyebrow rolled up. Mary smiled. She'd found his quizzical expression so disconcerting when she'd first seen it, but now she was used to it. The differences between them were so much less than the similarities.

But, still, all along, all this time, there had been a gulf between them—a gulf caused not by his being a member of a different species, but rather by the simple fact of his sex. And more than that. It wasn't *just* that he was male, but that he was so *overwhelmingly* male: muscled like Arnold Schwarzenegger; hairy all over; bearded; powerful, rough, and clumsy all at the same time.

"Ponter," she said, uttering his name for a third time now. "There's—there's something I have to tell you." She paused. Part of her thought it would be better not to give voice to this, to leave it, as she had so many other things, unspoken, unsaid. And, of course, there was a chance that by the time they reached the SNO chamber—still many minutes away, by lift and by foot—that whatever portal had magically appeared between his world and hers would be closed, and she would continue to see Ponter day in and day out, but with her having laid bare her soul, that ethereal essence that she believed they both had and that he was sure neither of them possessed.

"Yes?" said Ponter.

"You'd assumed," said Mary, "and I'd assumed, that whatever fluke of physics had deposited you here was irreproducible—that you were stranded here forever."

He nodded slightly, his large face moving up and down in the semidarkness.

"We thought there was no way you could get back to Jasmel and Megameg," said Mary. "No way to get back to Adikor. And though I know your heart belonged to him, to them, and always would, I also knew that you were resigning yourself to making a life in this world, on this Earth."

Ponter nodded again, but his eyes shifted away from her. Perhaps he saw where this was going; perhaps he felt nothing more needed to be said.

But it *had* to be said. She had to make him understand—make him understand that it wasn't him. It was her.

No, no, no. That was wrong. It wasn't her, either. It was that faceless, evil man, that monster, that demon. *That's* who had come between them.

"Just before we met," said Mary, "on the day you arrived here in Sudbury, I was . . ."

She stopped. Her heart was pounding; she could feel it—but all she could hear was the clattering rumble of the lift.

The elevator passed the 1,200-foot level. She could see a miner out in the drift, waiting for a ride up, his harsh headlight beam lancing into the cage, no doubt briefly playing across her face and Ponter's, a stranger intruding from outside.

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Ponter said nothing; he just waited quietly for her to go on. And, at last, she did. "That night," Mary said, "I was . . ."

She'd intended to say the word baldly, to pronounce it dispassionately, but she couldn't even give it voice. "I was . . . hurt," she said.

Ponter tilted his head, puzzled. "An injury? I am sorry."

"No. I mean I was *hurt*—by a man." She took a deep breath. "I was attacked, at York, on the campus, after dark"—pointless details delaying the word she knew she'd have to say. She dropped her gaze to the lift's mud-covered metal floor. "I was raped."

Hak bleeped—the Companion had the sense to do so at a great volume so that the sound could be heard over the noise of the elevator. Mary tried again. "I was assaulted. Sexually assaulted."

She heard Ponter suck in air—even over the rumble of the lift, she heard his gasp. Mary lifted her head and sought out his golden eyes in the semidarkness. Her gaze flickered back and forth, left and right, from one of his eyes to the other, looking for his reaction, trying to gauge his thoughts.

"I am very sorry," said Ponter, gently.

Mary assumed he—or Hak—meant "sorry" in the sense of sympathy, not contrition, but she said, because it was all that occurred to her to say, "It wasn't your fault."

"No," said Ponter. It was now his turn to be at a loss for words. Finally, he said, "Were you hurt—physically, I mean?"

"Roughed up a little. Nothing major. But . . ."

"Yes," said Ponter. "But." He paused. "Do you know who did it?"

Mary shook her head.

"Surely the authorities have reviewed your alibi archive and—" He looked away, back at the rock wall flashing by. "Sorry." He paused again. "So—so he will get away with this?" Ponter was speaking loudly, despite the delicacy of the matter, in order for Hak to pick up his voice over the racket around them. Mary could hear the fury, the outrage, in his words.

She exhaled and nodded slowly, sadly. "Probably." She paused. "I—we didn't talk about this, you and I. Maybe I'm presuming too much. In this world, rape is considered a horrible crime, a terrible crime. I don't know—"

"It is the same on my world," said Ponter. "A few animals do it—orangutans, for instance—but we are people, not animals. Of course, with the alibi archives, few are fool enough to attempt such an act, but when it is done, it is dealt with harshly."

There was silence between them for a few moments. Ponter had his right arm half raised, as if he'd thought to reach out and touch her, to try to console her, but he looked down and, with an expression of surprise on his face, as if he were seeing a stranger's limb, he lowered it.

But then Mary found herself reaching out and touching his thick forearm herself, gently, tentatively. And then her hand slid down the length of his arm and found his fingers, and his hand came up again, and her delicate digits intertwined with his massive ones.

"I wanted you to understand," said Mary. "We grew very close while you were here. We talked about anything and everything. And, well, as I said, you thought you were never going home; you thought you would have to make a new life here." She paused. "You never pushed, you never took advantage. By the end, I think, you were the only man on this entire planet that I was getting comfortable being alone with, but . . ."

Ponter closed his sausagelike fingers gently.

"It was too soon," said Mary. "Don't you see? I—I know you like me, and . . ." She paused. The corners of her eyes were stinging. "I'm sorry," she said. "It hasn't happened often in my life, but there have been times when men were interested in me, but, well—"

"But when that man," Ponter said

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slowly, "is not like other men . . ."

Mary shook her head and looked up at him. "No, no. It wasn't because of that; it wasn't because of the way you look—"

She saw him stiffen slightly in the strobing light. She didn't find him ugly—not anymore, not now. She found his face kind and thoughtful and compassionate and intelligent and, yes, dammit, yes—attractive. But what she'd said had come out all wrong, and now, in trying to explain so his feelings wouldn't be bruised, so he wouldn't be left wondering forevermore why she'd responded the way she had to his soft touch when they were stargazing, she'd ended up hurting him.

"I mean," said Mary, "that there's nothing wrong with your appearance. In fact, I find you quite"—she hesitated, although not from lack of conviction, but rather because so rarely in her life had she ever been so forward with any man—"handsome."

Ponter made a sad little smile. "I am not, you know. Handsome, I mean. Not by the standards of my people."

"I don't care," said Mary at once. "I don't care at all. I mean, I can't imagine you found me attractive physically, either. I'm . . ." She lowered her voice. "I'm what they call plain, I guess. I don't turn a lot of heads, but—"

"I find you very striking," said Ponter.

"If we'd had more time," said Mary. "If *I'd* had more time, you know, to get over it"—not, Mary was sure, that she ever would—"things . . . things might have been different between us." She lifted her shoulders a bit, a helpless shrug. "That's all. I wanted you to know that. I wanted you to understand that I did—do—like you."

A crazy thought ran through her head. Had things indeed been different—had she come up to Sudbury a whole person, instead of shattered inside, maybe now Ponter wouldn't be rushing as fast as he could to return to his old life, his own world. Maybe . . .

No. No, that was too much. He had Adikor. He had children.

And, anyway, if things *had* been different, maybe *she* would be getting ready to go with him, through the portal, to *his* world. After all, she had no one here, and—

But things were *not* different. Things were precisely as they were.

The lift shuddered to a halt, and the buzzer made its raucous call, signaling the opening of the cage door.

Chapter 45

Suddenly there was considerable commotion among the Gliksins. At first, Adikor couldn't tell what was going on, but then he realized someone was coming down into the barrel-shaped chamber, descending the same long ladder they'd seen before. The person's broad back was facing the robot's eye; presumably, it was a Gliksin leader, come to make an assessment of this strange contraption, that—if the effect was mirrored on the other side—appeared to be attached to a cable that was protruding from thin air.

The Gliksins visible in the foreground were beckoning for the newcomer to approach. And he did, running quite fast. The robot was swinging at the end of its tether, as Dern hauled it higher and higher, but then Adikor caught a glimpse on the monitor of the face of the person who had just arrived.

Yes! Incredibly, wonderfully yes!

Adikor's heart was pounding. It was Ponter! He was clad in the strange clothing of the Gliksins, and wearing one of those plastic turtle shells on top of his head, but there could be no doubt. Ponter Boddit was alive and well!

"Dern!" shouted Adikor. "Stop! Let the robot back down!"

The camera's perspective started lowering on the screen. Jasmel gasped and clapped her hands together with glee. Adikor wiped tears from his eyes.

Ponter hurried over to the robot. He bent his head oddly, and it took Adikor a

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moment to realize what Ponter was likely doing: looking at the manufacturer's contribution stamp on the robot's frame, confirming for himself that this really was an artifact from his own world. Ponter then looked up into the robot's camera lens, grinning widely.

"Hello," said Ponter—the first word out of the cacophony that Adikor had understood. "Hello, my friends! I'd thought I'd lost you forever! Who's looking at this, I wonder? Adikor, no doubt. How I've missed you!"

He paused, then two of the Gliksins spoke to him: one of the light-skinned ones and the dark-skinned man who had been holding on to the robot earlier.

Ponter turned back to the camera. "I'm not sure what I'm supposed to do now. I see the cable coming out of the air, but is it safe for me to cross back over? Can"—his voice caught for a moment—"can I come home?"

Adikor turned away from the screen and looked at Dern, who had returned to the control room. Dern lifted his shoulders. "The robot seemed to come through just fine."

"You don't know how long you'll be able to keep the gate open," said Jasmel, "or whether you'll ever be able to establish it again if it closes. He should come through right now."

Adikor nodded. "But how do we let him know that?"

Jasmel said decisively, "I know how." She hurried down the steps onto the computing floor, then strode over to where the cable disappeared into the hole in the air. Jasmel placed her hand on the cable, then slid her grip along the cable's length until her fingertips, then her whole fingers, then her hand, then her forearm disappeared. When everything up to her shoulder was projecting through, she shoved her head over into the other side, and simply shouted out—Adikor and Dern could hear it, but it came entirely from the speaker on the monitor; there was no sound at all coming from the computing floor—"Daddy! Come home!"

"Jasmel, sweetheart!" shouted Ponter, looking up. "I—"

"Come right now!" Jasmel replied. "There's no telling how long we can keep this open. Just follow the cable—use that ladder, there, to get up here. The computing-room floor is about half an armspan below where my head is; you should have no trouble finding it."

Jasmel then pulled her head back over to her side and ran over and up into the control room.

There was a flurry of activity visible on the monitor; it was clear no one was quite prepared for this. Two men went to get the ladder Jasmel had indicated. One of the men gave Ponter a great hug, which Ponter enthusiastically returned—it seemed that he hadn't been mistreated by the Gliksins.

And now a yellow-haired woman had appeared next to Ponter; she hadn't been there before, and she looked quite winded. She stood on her toes and pressed her lips against Ponter's cheek; he smiled broadly in return.

The robot swiveled its camera under Dern's command, and Adikor saw that the problem was more difficult than Jasmel had thought. Yes, the cable was protruding from a hole—but that hole was nowhere near any part of the cavern's rocky walls. Rather, it was in the middle of the air, several body-lengths above the ground, and at least that far from the closest wall. There was nothing to lean the ladder against.

"Could he climb the cable?" asked Adikor.

Dern shrugged. "He outweighs the robot, I'm sure. It *might* hold him, but . . ."

But if it snapped, Ponter would crash down to the rock floor, possibly breaking his back.

"Can we get a stronger cable through to him?" asked Jasmel.

"If we *had* a stronger cable," said Dern, nodding. "But I've no idea where to get one down here; I'd have to go up to my workshop on the surface, and

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that'd take too long."

But the Gliksins, puny though they might be, were resourceful. Four of them were now holding the base of the ladder, steadying it with all their strength. It wasn't leaning against anything, but they were shouting at Ponter, presumably urging him to try climbing it anyway.

Ponter ran over to the ladder, and was about to step onto the first rung, even though it was still none too steady. Suddenly, the yellow-haired woman ran up to him, and touched his arm. He turned, and his eyebrow rolled up his browridge in surprise. She pressed something into his other hand and stretched up to place her face against Ponter's cheek again. He smiled once more, then began climbing the ladder the Gliksins were holding on to.

The ladder swung more and more the higher Ponter got, and Adikor's heart jumped as it looked like it was going to come crashing down, but more Gliksins rushed to help, and the ladder was straightened again, and Ponter started reaching out with his hand, trying to grab the cable just shy of where it protruded from the midair hole. The ladder swung back, forth, left, right, and Ponter grabbed, missed, grabbed again, missed once more, and then—

Dern's control box jerked forward slightly. Ponter had the cable!

Adikor, Jasmel, and Dern rushed down onto the computing floor. Jasmel and Dern had taken positions directly in front of the opening, and Adikor, looking to see if there was something he could do to help, moved ***behind*** the opening, and—

Adikor gasped.

He saw Ponter's head appear from nowhere, and, from this rear angle, Adikor could see into his neck as if it had been chopped clean through by some massive blade. Dern and Jasmel were helping pull Ponter in now, but Adikor watched, stunned, as more and more of his beloved emerged through the widening hole that hugged his contours—and as the slice through him worked its way down his body, now revealing cross sections through his shoulders; now through his chest with beating heart and inflating lungs; now through his guts; now through his legs; and—

And he was through! All of him was through!

Adikor rushed around to Ponter and hugged him close, and Jasmel hugged her father, too. The three of them laughed and cried, and, finally, disengaging himself, Adikor said, "Welcome back! Welcome back!"

"Thank you," said Ponter, smiling broadly.

Dern had politely moved a short distance away. Adikor caught sight of him. "Forgive us," he said. "Ponter Boddit, this is Dern Kord, an engineer who has been helping us."

"Healthy day," said Ponter to Dern. Ponter began walking toward him, and—

"No!" shouted Dern.

But it was too late. Ponter had walked into the taut cable, and it had snapped in two, and the part that projected into the Gliksin world reeled out through the gateway, and the gateway disappeared with an electric blue flash.

The two worlds were separate once more.

Chapter 46

Dern, clearly feeling like a public car without a passenger, politely left, heading back up to the surface, letting the family reunion occur in private. Ponter, Adikor, and Jasmel had moved to the small eating room in the quantum-computing lab.

"I never thought I'd see you again," said Ponter, beaming at Adikor, then at Jasmel. "Either of you."

"We thought the same thing," said Adikor.

"You're fine?" asked Ponter. "Everyone is fine?"

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"Yes, I'm all right," said Adikor.

"And Megameg? How is darling little Megameg?"

"She's fine," said Jasmel. "She really hasn't understood everything that's been going on."

"I can't wait to see her," said Ponter. "I don't care if it is seventeen days until Two next become One, I'm going to go into the Center tomorrow and give her a great big hug."

Jasmel smiled. "She'd like that, Daddy."

"What about Pabo?"

Adikor grinned. "She missed you awfully. She keeps looking up at every sound, hoping it might be you returning."

"That sweet bag of bones," said Ponter.

"Say, Daddy," said Jasmel, "what was it that female gave you?"

"Oh," said Ponter. "I haven't even looked myself. Let's see . . ."

Ponter reached into the pocket of his strange, alien pant, and pulled out a wad of white tissue. He carefully opened it up. Inside was a gold chain, and attached to it were two simple, perpendicular bars of unequal length, intersecting each other about one-third of the way down the longer of the two pieces.

"It's beautiful!" said Jasmel. "What is it?"

Ponter's eyebrow went up. "It's the symbol of a belief system some of them subscribe to."

"Who was that female?" asked Adikor.

"My friend," said Ponter softly. "Her name—well, I can only say the first syllable of her name: 'Mare.'"

Adikor laughed; "mare" was, of course, the word in their language for "beloved." "I know I told you to find yourself a new woman," he said, his tone joking, "but I didn't think you'd have to go that far to meet one who would put up with you."

Ponter smiled, but it was a forced smile. "She was very kind," he said.

Adikor knew his partner well enough to understand that whatever story there was to tell would come out in its own good time. Still . . .

"Speaking of women," said Adikor. "I, ah, have had some dealings with Klast's woman-mate while you've been away."

"Daklar!" said Ponter. "How is she?"

"Actually," said Adikor, looking now at Jasmel, "she's become rather famous in your absence."

"Really?" said Ponter. "Whatever for?"

"For making and pursuing a murder accusation."

"Murder!" exclaimed Ponter. "Who was killed?"

"You were," said Adikor, deadpan.

Ponter's jaw dropped.

"You went missing, you see," said Adikor, "and Bolbay thought . . ."

"She thought you had *murdered* me?" declared Ponter incredulously.

"Well," said Adikor, "you *had* disappeared, and the mine here is so deep within the rocks that the alibi archive pavilion couldn't pick up the signals from our Companions. Bolbay made it sound like the perfect crime."

"Incredible," said Ponter, shaking his head. "Who spoke on your behalf?"

"I did," said Jasmel.

"Good girl!" said Ponter, sweeping her up in another hug. He spoke over his daughter's shoulder. "Adikor, I'm sorry you had to go through this."

"Me too, but—" He shrugged. "You'll doubtless hear it soon enough. Bolbay said I resented you; she said that I felt like merely an adjunct to your work."

"Nonsense," said Ponter, releasing Jasmel. "I could have accomplished nothing without you."

Adikor tipped his head. "That's generous of you to say, but . . ." He paused, then spread his arms, palms up. "But there was truth in her words."

Ponter put an arm around Adikor's shoulders. "Perhaps the theories were indeed more mine than yours—but it was you who designed and built the quantum computer, and it is that computer that has opened up a new world

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to us. Your contribution exceeds mine a hundredfold because of that."

Adikor smiled. "Thank you."

"So what happened?" said Ponter. He grinned. "Your voice doesn't sound any higher, so I assume she didn't succeed."

"Actually," said Jasmel, "the case will be heard by a tribunal, starting tomorrow."

Ponter shook his head in wonder. "Well, obviously, we must have the accusation expunged."

Adikor smiled. "If you'd be so kind," he said.

The next morning, Adjudicator Sard was joined by a wizened male and an even more wizened female, one sitting on each side of her. The Gray Council chamber was packed with spectators and ten or so silver-clad Exhibitionists. Daklar Bolbay was still wearing orange, the color of accusation. But there was considerable whispering among the crowd when Adikor entered, for instead of the accused's blue, he had on a rather jaunty shirt with a floral print, and a light green pant. He made his way to the stool he'd gotten to know so well.

"Scholar Huld," said Adjudicator Sard, "we have traditions, and I expect you to observe them. I think by now you've learned how little patience I have for wasting time, so I won't send you home to change today, but tomorrow, I'll expect you to be wearing blue."

"Of course, Adjudicator," said Adikor. "Forgive me."

Sard nodded. "The final investigation of Adikor Huld of Saldak Rim for the murder of Ponter Boddit of the same locale now begins. Presiding tribunal consists of Farba Dond"—the elderly man nodded—"as well as Kab Jodler, and myself, Komel Sard. The accuser is Daklar Bolbay, on behalf of her late womanmate's minor child, Megameg Bek." Sard looked around the packed room, and a self-satisfied frown creased Sard's face; she clearly knew this was a case that would be talked about for countless months to come. "We will begin with the initial statement of the accuser. Daklar Bolbay, you may begin."

"With respect, Adjudicator," said Adikor, rising, "I was wondering if the person speaking for me might present my defense first?"

"Scholar Huld," said Dond, sharply, "Adjudicator Sard has already warned you about ignoring traditions. The accuser always goes first, and—"

"Oh, I understand that," said Adikor. "But, well, I *do* know of Adjudicator Sard's desire to speed things along, and I thought this might help."

Bolbay rose, perhaps sensing an opportunity. After all, if she went *after* the defense, she'd be able to pull it apart during her initial statement. "As accuser, I have no problem with the defense being presented first."

"Thank you," said Adikor, bowing magnanimously. "Now, if it—"

"Scholar Huld!" snapped Sard. "It is not up to the accuser to determine protocol. We will proceed as tradition dictates, with Daklar Bolbay speaking first, and—"

"I only thought—" said Adikor.

"Silence!" Sard was getting quite red in the face. "You shouldn't be talking at all." She faced Jasmel. "Jasmel Ket, only you should speak on Scholar Huld's behalf; please make sure he understands this."

Jasmel rose. "With great respect, Worthy Adjudicator, I am not speaking for Adikor this time. You did, after all, suggest that he find a more appropriate defender."

Sard nodded curtly. "I'm glad to see he can listen at least some of the time." She scanned the crowd. "All right. Who is speaking on Adikor Huld's behalf?"

Ponter Boddit, who had been standing just outside the Council-chamber doors, walked in. "I am," he said.

Some spectators gasped.

"Very well," said Sard, looking down, preparing to make a note. "And your name is?"

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"Boddit," said Ponter. Sard's head snapped up. "Ponter Boddit."

Ponter looked across the room. Jasmel had been restraining Megameg, but now she let her younger sister go. Megameg ran across the Council-chamber floor, and Ponter swept her up off the ground, hugging her.

"Order!" shouted Sard. "There will be order!"

Ponter was grinning from ear to ear. Part of him had worried that the authorities might try to keep the existence of the other Earth a secret. After all, it was only at the last moment that Doctors Montego and Singh had prevented Ponter from being taken away by the Gliksin authorities, possibly never to be seen again. But right now, thousands were using their Voyeurs at home to look in on what the Exhibitionists here were seeing, and a room full of regular Companions were transmitting signals to their owners' alibi cubes. The whole world—*this* whole world—would soon hear the truth.

Bolbay was on her feet. "Ponter!"

"Your eagerness to avenge me is laudable, dear Daklar," he said, "but, as you can see, it was premature."

"Where have you been?" Bolbay demanded. Adikor thought she looked more angry than relieved.

"Where have I been?" repeated Ponter, looking out at the silver suits in the audience. "I must say I'm flattered that the trifling matter of the possible murder of an undistinguished physicist has attracted so many Exhibitionists. And, with them all here and with a hundred other Companions sending signals to the archive pavilion, I will be glad to explain." He surveyed the faces—broad, flat faces; faces with proper-sized noses, not those pinched things the Gliksins had; hairy male faces and less-hairy female ones; faces with prominent browridges and streamlined jaws; handsome faces, beautiful faces, the faces of his people, his friends, his species. "But first," he said, "let me just say that there's no place like home."

Chapter 47

SIX DAYS LATER
Friday, August 16
148/119/10

Adikor and Ponter arrived at the home of Dern, the robotics engineer. Dern ushered them inside, then turned off his Voyeur—he was a fellow Lulasm fan, Ponter saw.

"Gentlemen, gentlemen!" said Dern, "it's good to see you." He pointed at the now-black square of the Voyeur. "Did you look in on Lulasm's visit to the Economics Academy this morning?"

Ponter shook his head; so did Adikor.

"Your friend Sard has stepped down from being an adjudicator. Apparently, her colleagues thought she looked something less than impartial, given the way your trial turned out."

"Somewhat?" said Adikor, astonished. "There's an understatement."

"In any event," said Dern, "the Grays decided she'd make a more meaningful contribution by teaching advanced mediation to 146s."

"It probably won't catch any Exhibitionist's eye," said Ponter, "but Daklar Bolbay is getting help now, too. Therapy for grief management, anger management, and so on."

Adikor smiled. "I introduced her to my old personality sculptor, and he's gotten her hooked up with the right people."

"That's good," said Dern. "Are you going to demand a public apology from her?"

Adikor shook his head. "I have Ponter back," he said simply. "There's nothing else I need."

Dern smiled and told one of his many household robots to fetch beverages. "I thank you both for coming over," he said, lying down on a long couch, ankles crossed, fingers interlaced behind his head, his round belly rising up and

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down as he breathed.

Ponter and Adikor straddled saddle-seats. "You said you had something important to talk about," said Ponter, prodding gently.

"I do," said Dern, lolling his head so that he could look at them. "I think we need to find a way to make the gateway between the two versions of Earth stay open permanently."

"It seemed to stay open as long as there was a physical object passing through the gateway," said Ponter.

"Well, yes, on short time scales," said Adikor. "We really don't know if it can be maintained indefinitely."

"If it can," said Ponter, "the possibilities are staggering. Tourism. Trade. Cultural and scientific exchange."

"Exactly," said Dern. "Have a look at this." He swung his feet to the floor and placed an object on the polished wooden table. It was a hollow tube, made of wire mesh, a little longer than his longest finger and no thicker than the diameter of his shortest one. "This is a Derkers tube," he said. He used the ends of two fingers to pull on the mouth of the tube, and the tube's opening expanded and expanded, its mesh with an elastic membrane stretched across it growing larger and larger, until it was as wide as Dern's handspan.

He handed the tube to Ponter. "Try to crush it," Dern said.

Ponter wrapped one hand around it as far as it would go, and brought in his other hand and encircled more of the tube. He then squeezed, lightly at first, and then with all his strength. The tube did not collapse.

"That's just a little one," said Dern, "but we've got them here at the mine that expand to three armspans in diameter. We use them to secure tunnels when a cave-in seems likely. Can't afford to lose those mining robots, after all."

"How does it work?" asked Ponter.

"The mesh is actually a series of articulated metal segments, each with ratcheting ends. Once you open it up, the only way to collapse it is to actually go in with tools and undo the locking mechanisms on each piece."

"So you're suggesting," said Ponter, "that we should reopen the gateway to the other universe, and then shove one of these—what did you call it? A 'Derkers tube'? Shove one of these Derkers tubes through the opening, and expand it to its full diameter?"

"That's right," said Dern. "Then people could just walk through from this universe to that one."

"They'd have to build a platform and stairs on the other side, leading up to the tube," said Ponter.

"Easily enough done, I'm sure," said Dern.

"What happens if the gate doesn't stay open indefinitely?" asked Adikor.

"I wouldn't suggest anyone linger in the tunnel," said Dern, "but presumably if the gate did shut down, it would simply sever the tunnel, cutting it into two parts. Either that, or it would draw the tunnel fully into one side or the other."

"There are issues to be concerned about," said Ponter. "I got very sick when I was over there; germs exist on the other side to which we have no immunity."

Adikor nodded. "We'd have to exercise caution. We certainly wouldn't want pathogens moving freely from their universe into ours, and travelers headed there would presumably require a series of immunizations."

"It could be worked out, I'm sure," said Dern. "Although I don't know exactly what the procedures should be."

There was silence between them for a time. Finally, Ponter spoke. "Who makes the decision?" he asked. "Who decides if we should establish permanent contact—or even reestablish temporary contact—with the other world?"

"I'm sure there are no procedures in place," said Adikor. "I doubt anyone has even considered the possibility of a bridge to another Earth."

"If it weren't for the danger of germs

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traveling here," said Ponter, "I'd say we should just go ahead and open up the gateway, but . . ."

They were all silent, until Adikor spoke. "Are they—are they good people, Ponter? *Should* we be in contact with them?"

"They are *different*," said Ponter, "in many, many ways. But they showed a lot of kindness toward me; I was treated very well." He paused, then nodded. "Yes, I do think we should be in contact with them."

"All right, then," said Adikor. "I suppose the first step is to make a presentation to the Gray Council. We should get to work on that."

Ponter had thought a lot about what Mare had said to him in the elevator on the way down to the neutrino observatory. Yes, he had indeed been interested; she had read him correctly. Even across species boundaries, even across timelines, some things were clear.

Ponter's heart was pounding. It seemed he was going to get to see her again.

Who knew what would come of it?

Well, there was only one way to find out. "Yes," said Ponter Boddit, smiling. "Let's get to work."

Usually, one had to wait until September for Toronto to be so heart-stoppingly beautiful, with the sky's complexion clear and flawless, the temperature *perfect*, and the wind a gentle caress—the kind of profound pleasantness that reminded Mary of just why it was that she believed in God.

But September was still two weeks away, and, of course, when Labour Day, that final, abrupt punctuation mark at the end of summer, came around, Mary would have to go back to work, back to her old life of teaching genetics, and having no one special, and eating too much. For now, though, for right now, with the wonderful weather, Toronto seemed like heaven.

While in Northern Ontario, Mary had lost a few of the extra pounds she normally carried around, but she knew they would return. Every diet she'd ever been on reminded her of Crisco oil: it all came back, except for maybe one tablespoon.

Of course, she hadn't been on a concerted diet. She simply hadn't been eating as much as usual. Part of it had been excitement during the time she'd spent in Sudbury, the time she'd spent with Ponter, over all the incredible things that had come and gone.

And part of it—the part that wasn't over, that could never be over—was the aftermath of the rape.

Mary had agreed to come in to York today for a departmental meeting, and so, for the first time since that horrible night—had it really been just seventeen days?—Mary had to walk by the spot on the campus where the attack had taken place, the concrete wall that the rapist, his head sheathed in a black balaclava, had slammed her body against.

But, of course, it wasn't because of the wall that she'd been raped. It was because of *him*—that monster—and the sick society that had produced him. As she passed by, she ran her fingers across the wall, taking care not to chip her red-painted nails—and, as she did so, a crazy thought occurred to her. She remembered another wall from long ago, one she and Colm had carved their initials into.

It was a ridiculous thing for a 38-year-old woman to contemplate, but maybe she should carve MV+PB here on this wall—although to do it right, she supposed, she should really carve MV plus the symbols in Ponter Boddit's language that represented his name.

Either way, she'd then smile every time she saw the wall, instead of being disgusted by it. To be sure, it would be a rueful smile, for she knew she'd likely never see him again. But, still, a memory of . . . *love*, yes: a memory of love lost was infinitely preferable to one of what had happened here.

Mary Vaughan continued on past the wall, forward, into the future. ■

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Maelstrom, Peter Watts, TOR, $25.95, 380 pp. (ISBN: 0-312-87806-0).

Eyes of the Calculor, Sean McMullen, TOR, $27.95, 589 pp. (ISBN: 0-312-87736-6).

Spherical Harmonic, Catherine Asaro, TOR, $27.95, 429 pp. (ISBN: 0-312-89063-X).

Chindi, Jack McDevitt, Ace, $?, ? pp. (ISBN: . . .).

Chronospace, Allen Steele, Ace, $22.95, 320 pp. (ISBN: 0-441-00832-1).

Myth-ion Improbable, Robert Asprin, Meisha Merlin, $14, 198 pp. (ISBN: 1-892065-55-X) (hc: $25, 1-892065-54-1).

50 in 50, Harry Harrison, TOR, $29.95, 623 pp. (ISBN: 0-312-87789-7).

Which Way to the Future? Stanley Schmidt, TOR, $24.95, 255 pp. (ISBN: 0-765-30104-0).

The Armageddon Blues, Daniel Keys Moran, Quiet Vision Publishing (12155 Mt. Shadow Road, Sandy, UT 84092 5812, 801-572-4018, http://www.quietvision.com), $34.99, 215 pp. (ISBN: 1-57646-576-4).

Emerald Eyes: A Tale of the Continuing Time, Daniel Keys Moran, Quiet Vision Publishing (12155 Mt. Shadow Road, Sandy, UT 84092-5812, 801-572-4018, http://www.quietvision.com), $39.99, 284 pp. (ISBN: 1-57646-577-2).

This seems to be a month for sequels, and mostly good ones at that. **Maelstrom** follows Peter Watts's *Starfish* (reviewed here in November 1999), which gave us a crowded world cramped by diminished energy supplies and kept going by infotech, nanotech, and food synthesizers. In search of energy, the power companies had planted extraction stations on seabed rift zones, and the tale began with the crew of one such station. Twisted people, they were surrounded by monsters—normally small abyssal creatures grown to huge size thanks to a primordial bacterium. The same bacterium was invading human bodies, and the crew's masters were scared. At the same time, a nuclear bomb was discovered on the rift, with a device that seemed to be seeking the perfect moment to trigger a quake that would inflict maximum damage on the west coast of North America. Natch, the power corps try to off their deep-sea crew even as the bomb goes off. But one woman survives. Engineered to stand deep-sea pressure and extract oxygen from water, Lenie Clarke is trudging across the seabed toward North America, wading through the thousands of decaying victims of the tsunami, and finally emerging from the surf to see the crowds of refugees that the US will not let past the shore. She is some pissed off, folks, and she's infected.

There's another survivor, too—assassin Ken Lubin, who will soon be hunting Lenie down, even as the refugees and ordinary people conspire to block his every step and the plague from the depths spreads, threatening to destroy every terrestrial ecosystem—and of course, quite incidentally, humanity itself, with all its works.

Meanwhile, the surfmeisters of the

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Net, people like Sou-Hon Perreault and Achilles Desjardins, are spotting anomalies, discovering a chain of fires linked to the deep-sea project, finding the growing myth that Lenie is a goddess, a demon, a ghost, and getting involved. A 95-megabyte computer virus, just one of the chaotic horde that dwells and evolves on the Net, is growing, recomplicating, and discovering that attaching the "Lenie Clarke" bitstring to its files is a magical way to prosper. Soon it is doing its best to keep Lenie Clarke free of Ken Lubin's attentions.

And in the end . . . I'm not about to give away the plot, but I will say that Watts confirms my 1999 statement that the enemy of humanity is humanity's own shortsighted stupidity and greed, the sort of thing that turns children into walking disaster zones, treats adults as interchangeable things, insists that unchecked fertility is a Good Thing, and values billions of dollars above billions of lives.

The ending may strike you—as it did me—as too pat, but you'll enjoy getting there.

Sean McMullen made a grand impression with *Souls in the Great Machine* (reviewed here in November 1999) and *The Miocene Arrow* (February 2001). His initial premise was a world brought low by global warming, an orbiting sunshade—Mirrorsun—gone awry to produce a Greatwinter, orbiting battle stations that destroy electronic devices and powered vehicles above a certain size, and the Call, a periodic psychic summoning that pulls people and large animals—but not birds—toward the sea and their deaths. Two thousand years later, civilization was struggling to rebuild, and in Australica a genius highliber (head librarian), Zavora, realized that a computer or "calculor" could be built using people as its repetitive operating units. The result was empire, and of course opposition, some of it from aviads, whose ancestors had been genetically engineered (with added bird genes) to resist the Call. One aviad faction wished to use their advantage to rule the world, and when civilization—based on diesel-powered airplanes and guns and built around chivalric duels—was discovered in North America's Mounthaven, they attempted to steal the technology. Fortunately, Mounthaven heroes defeated the aviads.

Now, in **Eyes of the Calculor**, Mirrorsun has awakened. It has destroyed the new electronic computers, as well as everything that uses electricity. Fortunately, the head librarian of Libris is quick to realize that human-powered calculors are needed anew. Unfortunately, a religious fanatic sees an opportunity to destroy technology and exterminate the aviads. Meanwhile, moderate aviads are struggling to rescue their persecuted fellows and get them to safety in Tasmania, while in Mounthaven, the heroes of the war are pushing for an expedition to Australica. It will be massively expensive, involving staging areas in Hawaii, Samoa, and New Zealand, but it promises an immense payoff in—at very least—horses to support the spread of the population into newly Call-free lands.

McMullen solves the problem of bridging long periods of time with character continuity by refusing to let his characters die. Zavora managed to be copied into the substance of Mirrorsun, and now she returns as a technologically enabled ghost. So does Glasken, who played major parts in both of the preceding novels. He's just as dead, but he was recorded by a special device, and now he can be read back into a mind vacated by shock—alas for him (he was a thorough rake!), his new body is female. From Mounthaven, we get Airlord Samondel Leover, a daring young woman who pushes the envelope outrageously to reach Australica, get shot down, and take cover as a university student. She is due to be betrayed, but she will find love as the world settles at last into "a

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period of relative stability, steady progress, and general prosperity." The bigots and luddites are defeated for the time being, and humans, aviads, cetozoids, and Mirrorsun can coexist in harmony.

If you enjoyed the earlier books, this one is a sure thing.

Catherine Asaro's "Saga of the Skolian Empire" began with *Primary Inversion* (reviewed here in July 1995). The long, long backstory began some six millennia in our past, when aliens transplanted a bunch of humans to the distant world of Raylicon. In due time, the Skolian Empire arose, led by the Ruby Dynasty of Rhons, gifted "projective empaths" who are the only ones who can operate the star-spanning mental network or psiberweb that coordinates the Empire. Then they genetically engineered a variant of themselves that became the evil Traders who so lack all empathy that they enslave everyone they can and torture projective empaths to fill their own inner voids with the thrills of agony. The ensuing war destroyed civilization. In time, the scars healed, and when the humans of Earth went out among the stars, they found Skolians and Traders already there. The Skolians, however, were now ruled by an Assembly, with the Rhons seen as a scarce and vital resource and managed with little regard to their wishes.

Asaro began her Skolian Saga with an unlikely love affair between Sauscony (Soz) Valdoria and Jaibriol, heir to the Trader Empire. She continued their story in *Radiant Seas*. Later volumes gave us the affairs of other members of the clan, always deeply embedded in galactic and imperial intrigues, until the Radiance War trashed the Traders, killed their emperor, all but exhausted the Skolians, and destroyed the psiberspace web.

Spherical Harmonic begins as Dyhianna Selei, chief Rhon, mathematical genius, and Ruby Pharaoh, painfully materializes from the remnants of psiberspace. Soon she is learning what happened to the Empire and her family—her husband Eldrin is a prisoner of the Traders and her son Taquinil is trapped in psiberspace—and drawing together the shattered remnants of the Skolian military. Questions abound: Can she get Eldrin back? Can Taquinil be rescued? Why are the Terrans refusing to let her kin return to Skolia? Was that Kelric (of *The Last Hawk*, reviewed here April 1998) she sensed in the tatters of psiberspace? Who are the four children being fostered on Earth by her first husband? Where did the *new* Jaibriol come from? And are they really mounting a coup against the Assembly to restore the glory days of Empire, when the Rhons sat on the throne?

And finally, can Skolia and Traders be reconciled at last? Is peace possible? But this question must await its answer in the forthcoming *The Moon's Shadow*.

Asaro gains interest for her twin trademarks. The first is romance, so strong a strain in her work that the usual SF reader must be startled—until he or she learns that Asaro also writes non-SF romances and is herself the techy-romantic hybrid of physicist and ballet dancer. The second is her repeated use of imagery from mathematics and physics—quantum scattering, wave functions, inversions, transforms, and spherical harmonics, of which she says in her concluding note: "My doctoral thesis brims with spherical harmonics, a pleasant set of equations to work out given the lovely images they create in my mind . . . The spark of creativity I feel when choreographing a dance is similar to what I feel when solving an equation, and the meditative quality of ballet class reminds me of working on a satisfying derivation. I first combined the two in a ballet called *Spherical Harmonic* that I choreographed . . ."

Asaro is an absorbing storyteller, but perhaps her greatest contribution to our culture is her insistent reminder that

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brain and heart need not be separate.

Jack McDevitt has established a reputation as an inventive and satisfying writer with such novels as *Moonfall* (reviewed here May 1998), *Eternity Road* (February 1998), *Infinity Beach* (January 2000), *The Engines of God* (April 1995), *Deepsix* (April 2001), and more. The last two featured Priscilla Hutchins as a starship captain ferrying researchers to interesting spots around that portion of the galaxy explored by humans. She sometimes feels rather like a bus driver, but she has a very un-bus-driverish talent for solving problems and pulling chestnuts out of fires.

Humans are alone in the galaxy of the Hutchins series. Life-bearing worlds are scarce, intelligence scarcer, and starfaring civilizations quite absent. Perhaps that absence is explained by *Engines'* alien force—the Omega Clouds—that hates straight lines and tours the galaxy seeking and destroying them, and the civilizations that tend to create them. Yet *Deepsix* gave us a world about to plunge into a gas giant and be destroyed; researchers found ruins and signs of evacuation arranged by aliens.

And now there's **Chindi**, which begins with researchers orbiting a neutron star and picking up a brief snatch of intelligent transmission. Is it just a fluke? Maybe, until a second snatch is caught, but still the Academy thinks it hardly worth intensive investigation—at least until the nuts of the Contact Society offer to fund the necessary journey. Priscilla, of course, gets the job of driving the bus.

In the interests of characterization, McDevitt puts a burr under Priscilla's saddle—even as an incipient romance is destroyed by distance and fate, a long-dismissed suitor, Tor, shows up as one of the contact nuts aboard the mission. But that doesn't slow down the action. Before long, it is clear that there are three invisible satellites all aiming signals at a distant star. When they follow those signals, they find a world whose sentient masters are now extinct thanks to nuclear war. They also find *another* set of satellites aiming signals elsewhere.

Obviously, they're hot on the trail of something. Should they follow? They're just amateurs, after all, and they really should get out of the way and let the pros take the field. Or so say the rather frantic pros back at the Academy! The contact nuts have a rather different idea. They are hounds baying on a hot scent, and off they go, even if a few of their number are about to pay the ultimate price.

And in due time, they find the *chindi*, a massive starship orbiting a planetary system—two gas giants, each with moons and rings, orbiting each other, with a moon orbiting the pair at right angles to their own orbital plane—that seems arranged for visual effect. A little exploration shows that the *chindi* is honeycombed with chambers, many of which contain what can only be exhibits, samples from worlds such as those they have already visited.

And then it begins to boost, with Tor—whom Priscilla is beginning to look a bit fondly upon after all—aboard. Unfortunately, though Priscilla can tell where it is going and get there first, it turns out to be a slower-than-light ship whose "slow" speed is too fast for Priscilla to match. Her FTL drive works by jumping ahead.

So there's the fire and the chestnuts. Since we know Priscilla's rep, we know she'll find a way, but all I'll tell you is that it's almost as dramatic as *Deepsix's* finale.

I'm looking forward to the next.

Allen Steele's **Chronospace** begins with an *Analog* science-fact article. NASA physicist David Murphy has written a piece suggesting flying saucers are time machines. Now he's in trouble with his superiors, supposedly for making it seem that NASA takes UFOs seriously. Any further articles must go

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through channels for approval.

Why is NASA upset? Well, it's a bureaucracy, so perhaps that's enough of an explanation right there. But Steele has given us an opening scene that makes it plain that UFOs are in fact time machines. What's more, the chrononauts visiting the Anasazi Indians are feeling the wind up their skirts because they get a glimpse of an "angel," a mysterious humanoid figure with vague winglike attachments. And back at Chronos Station in the year 2314, an expedition is being mounted to visit the *Hindenburg* to record its last voyage.

Meanwhile, Murphy is getting interest from none other than Gregory Benford—or a lookalike who seems surprisingly ignorant of Benford's work—getting suspicious, and being kidnapped by a gray-bearded gent who seems strangely familiar.

And another David Murphy is working for the government's Office of Paranormal Sciences, beerily BSing about UFOs as time machines, and being awakened from a hungover sleep to go chasing after a crashed saucer.

Which is in fact the *Hindenburg* expedition, fleeing the dreaded anomaly that threatened as soon as it became clear that something had gone terribly wrong. Something they did was apparently enough to keep the great zeppelin from its fiery crash, and they felt that they must flee homeward quickly, before they were stranded in a changed world. They are, of course, too late.

By now, the Astute Reader has a pretty good idea of what is going on. But even if that Reader thinks Steele can no longer surprise, Steele holds the interest with his portrayal of the Germany of the 1930s, his characters, and their jams, both physical and philosophical (predestination versus free will). And in the end, he uses those "angels" to provide an apocalyptic climax before finally letting the fuss die down.

You'd have fun even without the *Analog* connection.

* * *

Robert Asprin's last Myth-Adventures volume appeared in 1994. Now he's back with **Myth-ion Improbable**, another tale of apprentice magician Skeeve, his irascible mentor the Pervect Aahz, and the delectable Tananda. Life is getting dull when Skeeve remembers the supposed treasure map he bought in a previous adventure. Aahz is skeptical—A golden cow that gives gold-laced milk? In the same league as golden geese and ducks and such? C'mon now!

But what the heck. They visit the Bazaar on Deva for a bit of help from a shape-shifter who knows the ins and outs of dimensional travel and wants just five percent of the treasure for her services. That's five percent every time they come back for more directions.

And they're off, eventually to discover the dimension of Kowtow, where things turn out to be just a little bit inverted. For a bit, Skeeve *et al.* seem to have met their final pickle, but Skeeve is a fortunate lad with a gift for discovering just the right spell at the very last possible moment.

It's just as well Asprin gave us a break. The series and its primitive humor (much like that of Piers Anthony's Xanth stories) were getting stale despite Asprin's impressive inventiveness. But a break is just a break, and I was willing to pick this one up in hope that the freshness had returned. Alas, it hadn't, though the reason may have as much to do with Asprin's own admission that he had lost his grip on the "Myth" voice and did this one as a light "getting back in the groove" exercise. Asprin fans will enjoy it anyway, but others should look for one of the older books or wait for the next for a more satisfying experience.

After Harry Harrison (born Henry Maxwell Dempsey in 1925) sold his first SF story in 1950, he developed a career as an illustrator, comics illustrator and writer, and prolific author of true con-

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fessions and men's adventure yarns. But his true love remained science fiction, especially the variety to be found in this magazine in both its *Astounding* and *Analog* incarnations. The "Stainless Steel Rat" stories started appearing here in 1957. His first novel, *Deathworld*, was serialized here in 1960. In due time, he wrote *Make Room, Make Room*, which became the movie *Soylent Green*. And on and on: forty-five novels so far, as well as a host of short stories.

50 in 50 uses those short stories to honor the Harrison career. From "Rock Diver," the very first (which appeared in *Worlds Beyond* in 1951), to "The Road to the Year 3000" (*Nature*, 2000), fifty stories for fifty years. Aliens and inventions, robots and humor, issues such as population, Harrison on display as one of our most thoughtful, deft, and witty writers. One of our best, indeed.

And if, like me, you have been reading SF for a few decades, you will find many here that make you say, "I remember this one!" with a grin of anticipation.

I don't have to say much about this one. *Analog* has been famous for a long time for its editors' editorials, sometimes iconoclastic and always thought-provoking. The tradition was begun by John W. Campbell, Jr., continued for a while by Ben Bova, and carried into the present by Stanley Schmidt, who in his two decades-plus tenure has displayed a grand talent for questioning the unquestionable, goring sacred oxen, and in general encouraging you, his readers, to think about the world around you, the way it *really* works, and the direction in which it is moving.

But you know that. You also know that the thirty-five *Analog* editorials collected in **Which Way to the Future?** will justify your attention all over again. They also offer you a great opportunity to provoke thought in people who would never read the magazine. So buy two copies while you're at it, and give one away.

NOTABLE REISSUES

Quiet Vision Publishing is reissuing the works of Daniel Keys Moran in 500-copy limited editions, beginning with **The Armageddon Blues** (reviewed here in October 1988; it uses telepathy and time travel to try to prevent nuclear apocalypse) and **Emerald Eyes: A Tale of the Continuing Time** (reviewed here May 1989; more successful; a genetic engineering superman novel). The latter's sequels, *The Long Run* (January 1990) and *The Last Dancer* (June 1994), are soon to come. ■

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BRASS TACKS

Dear Stan,

I've sometimes spent a lot of time imagining horrific scenarios that involve various kinds of technology (though I'm proud to say that more often than not I'm more interested in the benefits of new technologies, mind you, as are many *Analog* writers). Part of me still wants to believe that what I saw on September 11, 2001 was just one of those SF scenarios—not real. Here we have the confluence of two major technologies: that of high-rise construction, and high-tech aircraft, plus a very sophisticated security system that had to be avoided for the attack to work, and was. This event would have been impossible a hundred years ago, and, hopefully, with the aid of new technologies, will be next to impossible (or at least inconceivable!) a hundred years in the future. The horror of what happened is far worse than many terror scenarios that I have read about, or discussed with other authors. However, it's a sad fact that there are potentially worse events that could happen. And I think that's where the most psychological damage has been done: the act of terror has literally confirmed all my worst fears.

Tuesday's "act of war" is going to change our lives in many ways. It has to, I think. That is the nature of technological development. We—humanity—are on a learning curve, not just in devising and operating technologies, but in learning all the potentials that can arise from the incorporation of new devices, and developing the ethics not to always act out the potentials that may exist.

Wolf Read (9/14/01)

Dear Mr. Schmidt:

I am very concerned about your editorial ("Barren Lands, Barren Minds") in the November issue of *Analog*.

You write of the need to open eyes and change attitudes, but it is your own attitude that I find most distressing and in need of correction. SUVs are wonderful things, you write, "in appropriate times and places." You then go on to describe "appropriate" places as the roadless savannas of East Africa and similar wild and untamed places. What is disturbing about this line of thought is the idea that anyone or anything other than the open marketplace should determine what is an "appropriate" car for someone to drive. I personally drive a Chevy Chevette (20 years old, 32 mpg). That was my choice; and my neighbor's choice was a Chevy Suburban—which is fine with me. Your editorial seems to imply pretty openly that some people are making the right choice and some are making the wrong choice and that you are qualified to know (and dictate?) the difference. Should your concern for nonrenewable resources such as gas and oil outweigh my neighbor's concern for his own nonrenewable resources, his three children?

What will come next in your decisions about choices that we common people are "inappropriately" making for ourselves? Will you decide that perhaps we should all dress alike in order to increase efficiencies of manufacturing, and thus saving energy? Will you decide

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that we should all stick to the same diet in order to increase efficiencies of crop planning (maybe we should subsist on a diet largely consisting of rice)? Will you decide that electing leaders is an inefficient way to run a nation, state, or city, and that you (and right-thinking people like you, of course) will simply appoint the leaders best qualified to make our decisions for us since we are so obviously incapable of making correct decisions on our own? Is this beginning to sound like a description of some Communist dictatorship? Then perhaps you see why I worry when an individual thinks he or she is qualified to tell others that their own purchasing decisions are "inappropriate."

One of the primary reasons that America is as free, prosperous, and successful as it is (the envy of the world) is that America once was (and to some extent still is) a nation where competition in the open marketplace determined the success or failure of both products and ideas. The marketplace here seems to have indicated that many people feel an SUV is appropriate for their needs. It is not "appropriate" for you to try to decide what is "appropriate" for anyone else to drive, wear, eat, or vote.

Bill Johnson
North Hollywood, CA

I'm sorry it hurt when your pet ox was gored, but this is "straw man" argument at its finest. If you'll check the dictionary I hope you have stashed away somewhere, I think you'll find that my use of "appropriate" was quite appropriate. It's a valid opinion for me to hold, and nothing more than that. Your third paragraph is dramatic and stirring, but has absolutely nothing to do with what I wrote—I did not and would not say or imply any of the things you rather fancifully attribute to me. Saying that I think something is not very appropriate to a use being made of it is a far cry from saying the government should tell you can't do it! There is, however, a thing or two that I hope might influence people's choices besides the open marketplace per se: *that the people participating in that market exercise common sense and recognize that there may be some significant considerations beyond their own personal comfort and convenience.*

Dear Stan,

I always enjoy your columns, and found "Barren Lands, Barren Minds" particularly interesting. Having clueless officials pass damaging laws is something to worry about, especially since there is a growing body of evidence that this trend is increasing. As one friend said, "Short term solutions have long term consequences."

You called for a campaign to make SUVs and limos unfashionable, but you missed thinking about why these expensive and inefficient vehicles became so popular. Isn't it odd that citizens would spend lavishly for huge SUVs that handle poorly, guzzle gas, and are rarely used off-road? The laws passed by our own government drove this trend.

I'll refer you to "The Toilet Totalitarians" in the July 9, 2001 *Forbes* (it is also available on www.forbes.com). It notes that having "that paragon of efficiency, the federal government" make economic choices for us often has exactly the opposite result to that for which the legislation was passed.

When cars were regulated for increased fuel efficiency, they became smaller. Collide with an old car, SUV, or truck, and you might as well be driving a roller skate. Not long ago, someone ran a stop sign right in front of my wife in a compact car. Our old Volvo was a total wreck, but it punted the toy aside. My wife was sore, but safe.

We bought another old Volvo, but many prefer new vehicles. Should it be surprising that people pay more to put their loved ones into trucks (vans and SUVs) so that their wives and children

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can see over all the other trucks and better survive accidents? Unfortunately, the usage of oil has *increased* significantly. Because of the law.

In similar fashion, water is becoming scarce. Hence, in 1992 the social engineers in Washington passed a law that says toilets must use no more than 1.6 gallons per flush. Guess what? The old 3.5-gallon toilets worked on the first try. The new ones have to be flushed 3 or 4 times to do the job. Hence, we have become a nation of four-flushers, and water usage has increased. And so it goes. . . . Because of the law.

So don't blame fashion. It may be stupid, but it's the law.

John D. Trudel

Well, yes, they are safer for the occupants (and more dangerous for anyone else who has a run-in with one). Maybe we should try a little more reliance on skillful and careful driving and less on having everybody who can afford them drive bigger and bigger wheeled fortresses.

Dear Stanley,

I have just received the November, 2001 issue of *Analog*, and it is September 13th, two days after the catastrophic terrorist attacks on the World Trade Center and the Pentagon. Turning to Brass Tacks, I find a letter criticizing Jeffery Kooistra for lending his support to the widespread and unscientific belief in psychic powers, followed by Mr. Kooistra's defense. As Mr. Kooistra points out, there is no conclusive proof that no one ever has accurate premonitions. After all, there is no way of even finding out what premonitions everybody is having. Most of these never become public knowledge.

However, in a world which is richly endowed with both professional and amateur psychics of every description (such as "Empress Dawn," who advertises in your very magazine), it is remarkable how little advance warning we ever receive of major disasters such as the one which occurred on September 11th. If psychic powers do exist, the psychics have let us down in a big way. Of course, so have our intelligence agencies. They, however, do not claim to have mysterious paranormal abilities—they can only gather information in the usual ways. Psychics promise much more—and deliver much less. Where are the psychics when we really need them, Mr. Kooistra? Do you mean to tell me that an event as important as the attack of September 11th could not have been predicted by any psychic? Did no one have the courage to speak up? I find this very strange, to say the least. Occam's Razor suggests that there simply are no real psychic powers. If you expect me to believe otherwise, you had better have some damned good evidence. And the next time we are going to have a major calamity, I want to hear about it in advance, OK?

David Palter
Toronto, Ont. Canada

The author replies . . .

Psychics of many stripes have been predicting that a disaster would befall Manhattan sooner or later for years. Even if we assumed all psychics were phonies, the sheer volume of predictions makes it almost impossible that all of them could be wrong about September 11, 2001 being the date of some kind of disaster. Hence, they are ignored, and rightly so.

Not being reliably psychic myself, I can only guess that, had Susie the Psychic shown up on TV on the night of September 10 with a prediction that two planes would plow into the WTC the next morning, people like Mr. Palter (and me, for that matter) would have ignored her. On the 11th, Mr. Palter might have been inclined to think that just maybe Susie had really had a vision. But on the 12th, when the FBI showed up to question her, he might instead invoke Occam's razor and assume that she was

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actually in on the plot in some way. Collusion and conspiracy are easier to accept than genuine psychic ability.

But if an accurate prediction of what is to happen were instead taken as evidence that the "psychic" was in on the plot, what then would serve as genuine proof of psychic ability in this case? What does Mr. Palter want "proof" to look like? Once he clues me in on this, I might be able to provide him with, if not proof, at least compelling evidence.

If Mr. Palter cares to look, I have no doubt that in the coming months he will be able to find stories from people who worked at the WTC, but who just couldn't make themselves go to work that day, because they had some variety of "funny feeling" unlike any they'd ever had before. Of course, these stories won't prove that any kind of psychic ability exists; they'll only serve as more anecdotal material suggesting that perhaps there is something to this psychic stuff. One thing I can predict with certainty is this: those who think they're alive today because they heeded that premonitional warning won't give a damn whether Mr. Palter believes in premonitions or not.

Jeffery D. Kooistra

Dear Stanley,

As a recent student of Chinese history, I have to say I was very disappointed in "Trafalgar Square" by Sarah A. Hoyt (November 2001). This alternate history tale is based on a set of crude, simplistic and downright false assumptions about history.

The author postulates an alternate world in which the histories of Europe and Asia evolved in almost exact mirror-image, with present-day China being a capitalist democracy and Europe a patchwork of decaying communist states. This is allegedly because of one historical change, namely that the Mongols conquered Europe instead of Asia. The crux of her argument is spelled out on p. 79: "What if the Mongols . . . had gone into China instead, just when Chinese culture was breaking out of its early, rigid mold? What if it had squashed China's democratic roots before they ever could develop?"

I don't know where Hoyt got these ideas, because they certainly have nothing to do with Chinese history. In fact, under the Song Dynasty which preceded the Mongol conquest, the Chinese state was growing more authoritarian, as its bureaucratic system matured and enabled more effective centralized control. Far from crushing some native democratic spirit, the Mongols continued and amplified these authoritarian trends. And the post-Mongol Ming Dynasty certainly did not continue in the Mongols' vein—rather, they strove to erase every remnant of Mongol influence from their culture. In a reaction to the Mongols' oppression, the early Ming rulers were relative populists who attempted to create greater egalitarianism than China had ever known before (within the parameters of an imperial system, of course). As for rigidity, that came in later centuries, as the bureaucratic examination system became more formularized and ossified.

The one real legacy of Mongol rule was that China developed a distaste for outside contacts and began to turn inward. Perhaps this does mean that a China unconquered by the Mongols might have been more interested in the rest of the world. But it's still naive to assume they would have become a colonial, capitalist power exactly as Europe did. Europe was a poor subcontinent whose economic prosperity depended heavily on overseas trade, investment and agrarian settlement. China, however, was an entirely self-sufficient economy. It pursued foreign trade mainly for diplomatic reasons, and prestige demanded that it always give away more than it received. Therefore, even without xenophobic tendencies, China still would not have had the incentives for colonization and economic imperialism that drove Europe.

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Arguably, a Mongol-ravaged Europe would have had just as great a need for overseas commerce and colonization as the historical Europe did after being ravaged by the bubonic plague (transmitted, by the way, across the trade routes made possible by the stability which the Mongol Empire brought to Central Asia). Never mind the fact that the Mongols would never have been such successful conquerors in the first place if they hadn't first conquered the Jurchen of North China and acquired their knowledge of ironworking, stirrups and siegecraft. Hoyt's alternate history just doesn't work.

But Hoyt's premise is disturbing on a deeper level. The implicit assumption is that Chinese history would've been just like Europe's if it hadn't been "derailed" by the Mongols. This kind of thinking—that Europe's historical patterns are the "natural" or "default" course of human development, and that any culture which develops differently has somehow "gone off course"—is the worst kind of ethnocentrism. This kind of thinking has prevented Western scholars and statesmen from understanding China for centuries, because it makes us try to force China to fit our molds rather than facing it on its own terms. It also keeps us from understanding our own history, for by assuming ours is the "default" pattern we fail to examine its true causes.

Say someone were to submit a story set in an alternate universe where Earth and Mars had been in each other's orbits, and claiming that because of this the two planets had duplicated each other's climatic conditions and evolution exactly, so that Mars had its own human race writing books called *Blue Earth* and *The Songs of Distant Mars*. Say the author had ignored the easily obtainable data about the two planets' mass, gravity, geography and so forth, and just made up random figures to fit her goal of making Mars look like Earth and Earth look like Mars. Such a scientifically inept and dishonest story would never have made it out of the slush pile.

Well, history is a science too. True, it's not as exact a science as astronomy or geology, but it does involve the gathering of large amounts of data and the extrapolation of patterns and probabilities from those data. "Trafalgar Square" makes no effort to extrapolate credibly from that existing body of knowledge, and thus is a work of pure fantasy, not science fiction. I'm disappointed that the standards which *Analog* applies with regard to the "hard" sciences have not been applied here.

Christopher L. Bennett

The author replies . . .

What Mr. Bennett views as a simplistic version of history is instead history seen through a wider-angle lens than that which has informed his schooling. As a long-time student of world history, I've found that in the few instances when history works as a predictive tool, it is through comparative history.

The fictional Chinese society I extrapolated in my story, "Trafalgar Square," does not follow a mirror image of present-day Europe, except in certain aspects which seem inevitable in the human condition.

First, I never claimed that bureaucratic autocracy was a Mongol invention, nor that the Mongol rule remained long enough to make an impact on Chinese society. I simply claimed the shock of the invasion changed the course of Chinese history. Most historians do not disagree with this point.

The fact that the Song Dynasty was growing more authoritarian, while true, does not invalidate my hypothesis. What spurred the authoritarian laws of the Song was what historians of the period refer to as "decadence," meaning a flourishing of unusual art, a rise of a mercantile class, and the old divisions of birth being disregarded. I advise comparing this period to France in the last twenty-five years before the French Rev-

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olution. Would it have led to a populist revolution in China? Hard to tell. History has no exact rules for predicting such things. It was, however, a possibility.

As for the behavior of the Ming dynasty, I'm not sure what Mr. Bennett means by "populist egalitarianism in the framework of an empire." Ming policies always seemed to me to betray a disregard for the individual in favor of the nation. Was this a legacy from the Mongol invasion? Was the lack of resistance to this enforced populism the reaction of a shell-shocked country? Again, history—lacking exact rules—lacks the capacity to analyze and predict such situations.

As for the Chinese tradition of isolationism, it is not naive to assume that an undisturbed China would be colonial and capitalist. Although this combination was invented by a middle-eastern people, the Phoenicians, the history of the world is, unfortunately, full of less peaceful forms of colonialism. The Zulu expansionism of the nineteenth century comes to mind. However, the Chinese were sophisticated and they already had a monetary system, so commercial activity and some form of capitalism was not out of the question.

I do not understand Mr. Bennett's reference to Europe as needing overseas commerce. I'm afraid I can only attribute this to confusing Europe with the British Isles. Europe, throughout most of the Middle Ages, transacted commerce almost exclusively within itself and had more than sufficient goods to maintain it. Its famines, though cyclical, were not nearly as severe as those experienced in Africa and Asia. In fact, European voyages of exploration depended on a considerable surplus of goods (to feed the workers who built the ships, the mariners who went, and to be able to dispense with the labor of both at growing food) that would simply not be attainable in a poor society. Oh, there was some limited commerce with other continents—such as the furs that brought the plague to Europe—but overseas travel was expensive and lengthy, particularly before the fifteenth century and it was undertaken exclusively for luxury goods like silk and spices. Luxury goods—by definition—are not needed, but rather, created wants. No country is so rich or self-sufficient that it can't acquire a want for the goods of other countries. The history of the United States illustrates this—as does the history of Italy and the history of present-day China.

As for viewing Europe's patterns as natural, I don't recall in my story giving the Chinese a European mode of dress, religion or building, nor did I make any real reference to familial structure, familial tradition, holidays, societal beliefs or public modes of interaction. Since these are the primary expressions of a culture, I'm left to assume that what Mr. Bennett objects to is the assumption that left to its own devices, China would have become a free-market society. I agree with Mr. Bennett that this is unlikely (although not impossible). Most countries left to their own devices come up with variant of egalitarian theory which offers a moral justification for oppressing the greater majority in favor of the enlightened minority.

However, for my fictional story, I chose to depict the best of China's potential. My studies of the country's philosophy and my reading of their pre-twentieth century literature has left me with an abiding respect for the nation's potential. For the possibility of this future, I'll refer Mr. Bennett to the history of the late twentieth century, in which every country that was allowed the opportunity did indeed become a free-market society, including several Asian countries. Individuals want what's best for them and their families and this—if force doesn't stand in the way—usually leads to free markets. Free markets, in turn, crave expansion and more clients and better luxury products. This is hardly a characteristic of Europeans, as travel around the world proves.

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I find Mr. Bennett's assertion that the Chinese are so profoundly different from us that we have to understand them on different terms to be profoundly offensive and racist. Doubtless, the Aryan Nations would agree with him. In fact, what has stood in the way of our understanding the Chinese is not an assumption of similarities, but an assumption that they are different. From the first recorded contact with Asian civilizations, every tinpot moralizer expounded on "the mysterious mind" of the Oriental and how "they're just different." This is patently not true, as Chinese immigrants in our country do quite well and integrate seamlessly into our patterns after a couple of generations. The racial differences of humans, at the DNA level, are so irrelevant that if we were dogs we'd all be one breed.

Differences in behavior that do exist in individuals of different nationalities grow out of the different history that bred each individual culture. This was the whole point of my story, and I'm sorry Mr. Bennett doesn't like that point.

His example concerning Mars and Earth is preposterous. Unlike the measurements and precise data about Mars and Earth, history changes according to who recorded it, who assembled it and the assumptions of who reads it. It is, in fact, a lot like the "science" of the middle ages, in which memorized facts were more important than observed reality, as, I'm afraid, Mr. Bennett's letter proves. History is in no way a science; it cannot predict outcomes from a set of circumstances. I note that no historian, let alone a reputable majority of them, predicted the fall of the Soviet Union, Japan's economic ascension, or even the tragic events of September 11th 2001.

From Mr. Bennett's use of terms such as "economic imperialism", and "ethnocentrism" and his belief that Europe is the only country ever to search other shores for goods, I assume that he is still in school and still not expected to challenge his professors' views or accept dissenting opinions.

I recommend, however, that he read world history and compare it against what everyone knows to be true, such as the involvement of the U.S. in the world, the fact that European expansionism required a rich continent, not a poor one; the fact that infants have no culture; and that when people are afforded the opportunity, they do tend towards what he so quaintly calls economic imperialism.

The idea that most people in the world are alike under the skin might not be palatable in academia right now—to be honest, it rarely has been. The excuses are now different, of course. Racism has a way of raising its ugly head in different guises in every generation. Yet the similarity between humans of all races is more obvious than the fact that the Earth circles the Sun. No amount of denying it will change it.

Sarah A. Hoyt

Dear Stan,

In regards to Poul Anderson's description of the ranus bulb ("Lanets and Selements," November 2001):

First, ranus bulbs are best prepared by simmering them in a pan of weak tea. The tannin in the tea firms up the bulbs' microtubules, giving the bulbs a pleasant crunchiness reminiscent of celery without the nasty little bits of string.

Secondly, I object to his casual use of "fastidious" in the description of pigs. Many pigs are indeed fast, hence the tradition of pursuing a greased pig instead of a greased giant tortoise. However, most pigs are pleasing to the eye and should not be described as 'idious.

I trust that these clarifications will prevent continuing confusion.

Peter A. Lynn
Manhasset, NY ■

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UPCOMING EVENTS Anthony Lewis

29 March–1 April 2002
HELICON 2 (British EASTERCON) at Hotel de France, St Helier, Bailiwick of Jersey, Channel Islands. Guests—Brian Stableford, Harry Turtledove, Peter Weston. Registration—USD50/GBP30/EUR50 (checks to Helicon 2). Info—Helicon 2, 33 Meyrick Drive, Wash Common, Newbury, Berkshire RG14 6SY, UK; email—helicon2@smof.demon.co.uk; URL—www.smof.demon.co.uk/helicon2.htm

5–8 April 2002
WILLYCON 2002 (Nebraska SF conference) at Wayne State College, Wayne NE. Theme—The "Science" of Science Fiction. Guest of Honor—James P. Hogan; Artist Guest of Honor—Terese Nielsen. Registration—$15. Email—scifict@wscgate.wsc.edu; URL—www.wsc.edu/student/activities/clubs/sfclub/willycon

25–28 April
NEBULA AWARDS BANQUET WEEKEND (SFWA Awards banquet and program) at Westin Crown Center, Kansas City MO. URL—www.kcsciencefiction.org/2002nebs.htm

29 August–2 September 2002
CONJOSE (60th World Science Fiction Convention) at Convention Center, et al., San Jose, CA. Guests of Honor—Vernor Vinge, David A. Cherry, Bjo & John Trimble; TM—Tad Williams. Registration—$160 until 31 December 2001, more thereafter; supporting—$35. [These are the latest rates posted on the Internet as of the time this column went to press.] This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info—ConJose, Box 61363, Sunnyvale, CA 94088-1363; email—info@conjose.org; URL—www.conjose.org

31 October–3 November 2002
WORLD FANTASY CONVENTION at Hilton Minneapolis and Towers, Minneapolis MN. Guests of Honor—Dennis Etchison, Jonathan Carroll, Kathe Koja, Stephen Jones, Dave McKean. Registration—TBA (under $100). Info—World Fantasy Convention, c/o DreamHaven Books, 912 West Lake St., Minneapolis MN 55408; phone—(612)823-6161; fax—(612)823-6062; email—wfc@dreamhavenbooks.com; URL—www.dreamhavenbooks.com/wfc.html

Convention runners: If your convention has a telephone, FAX, email, or Web page URL, please let us know so that we can publish this information.

Convention attendees: When calling conventions for information, do not call collect and do not call too late in the evening. It is best to include a S.A.S.E. when requesting information; include an IRC if the convention is in a different country. ■

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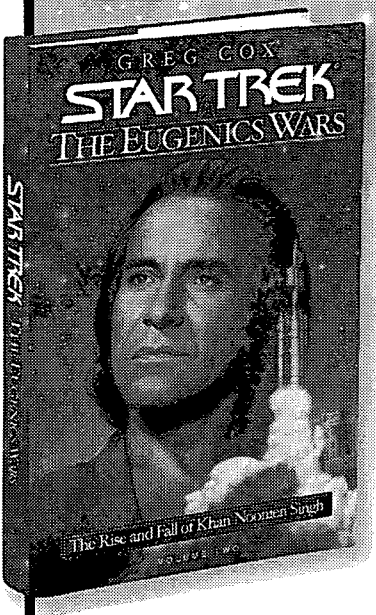

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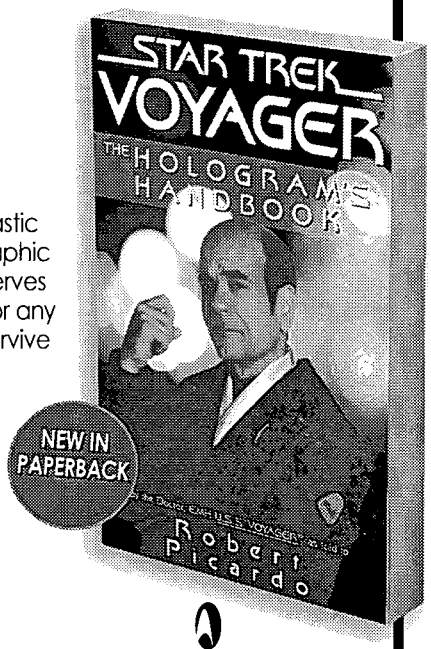

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